

Review of 2011 GFS Forecast Skills

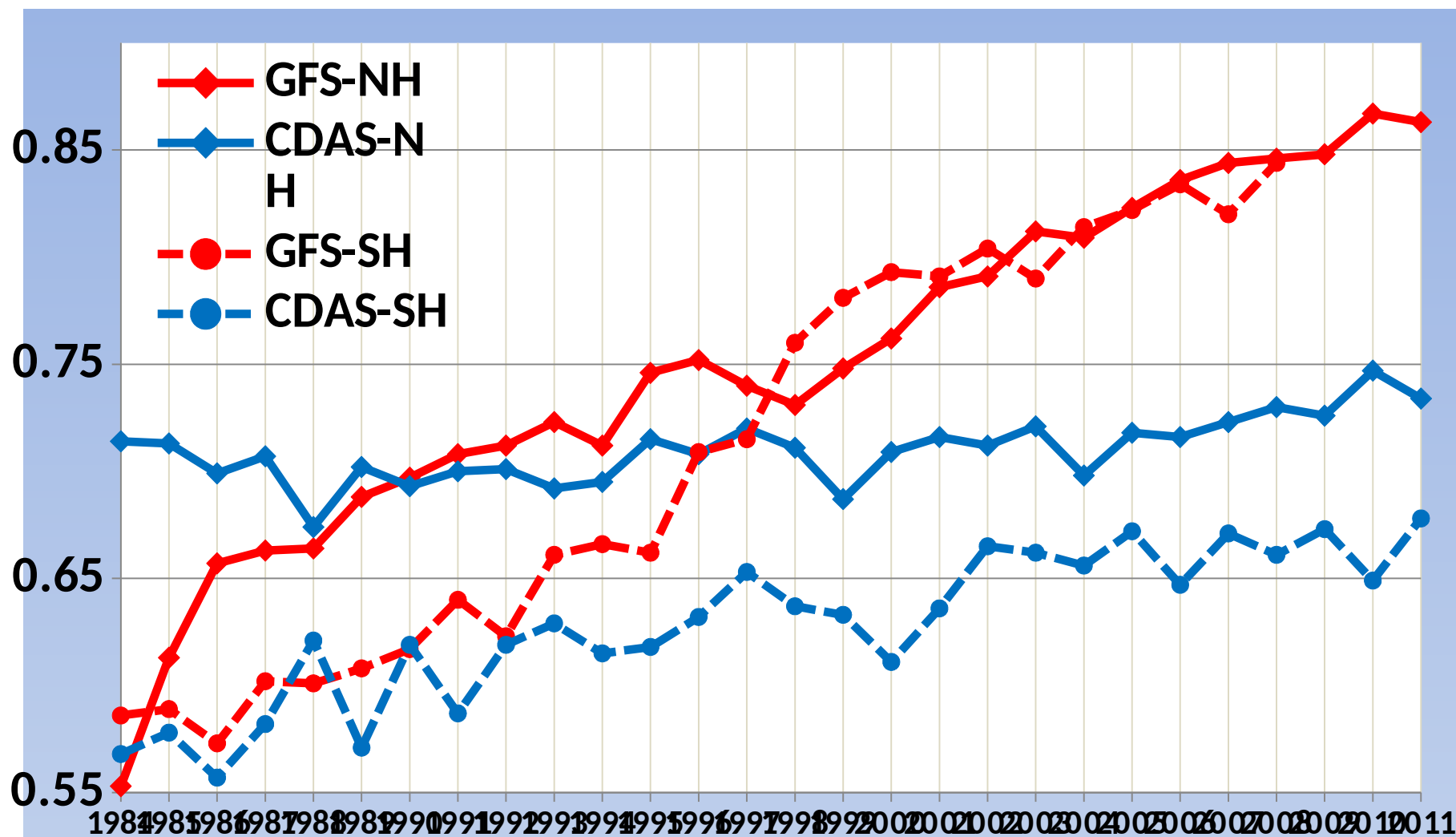
Fanglin Yang

NCEP/EMC Global Branch

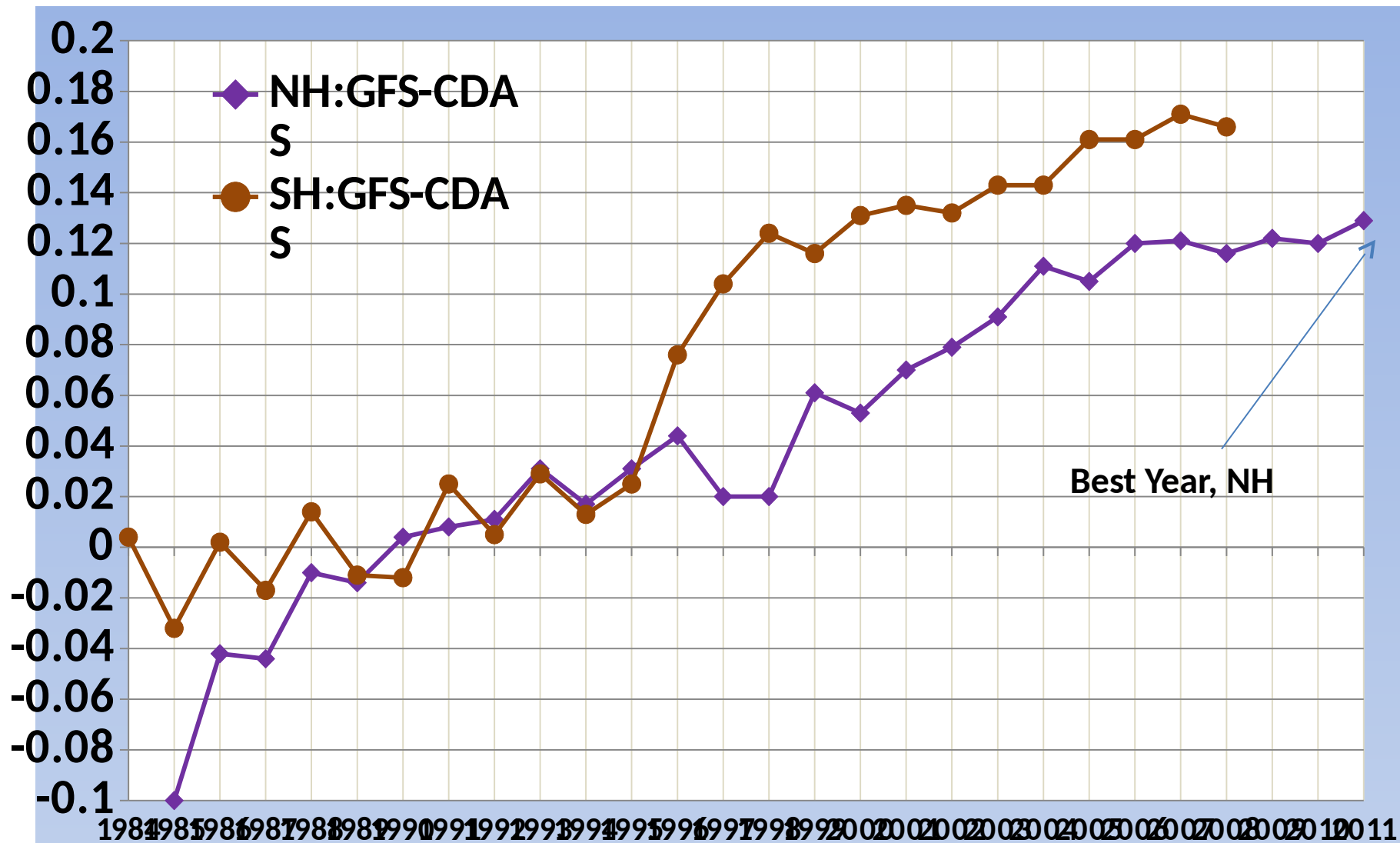
02/23/2012

http://www.emc.ncep.noaa.gov/gmb/STATS_vfdb/

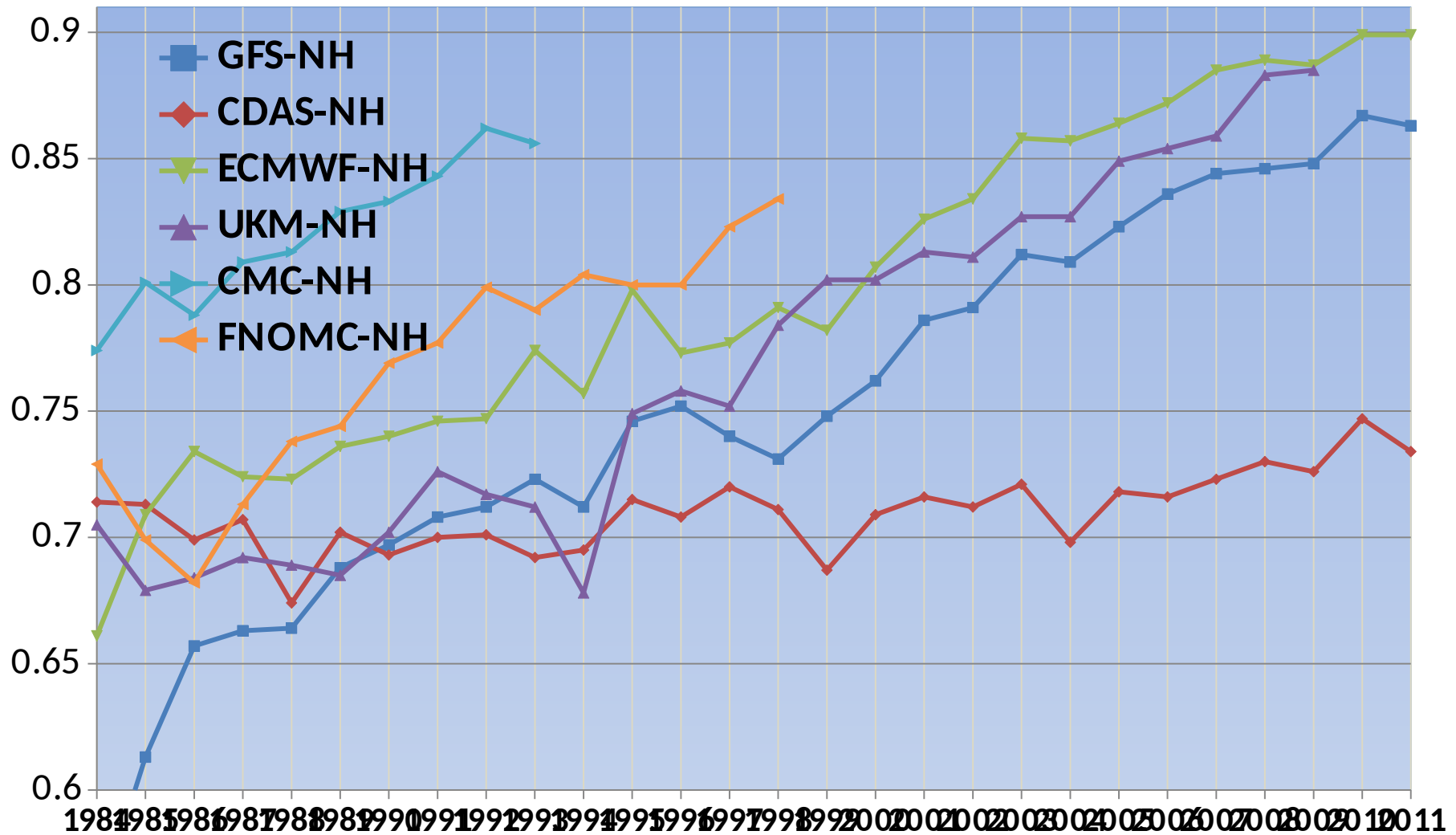
Annual Mean 500-hPa HGT Anomaly Correlation



Annual Mean 500-hPa HGT Anomaly Correlation

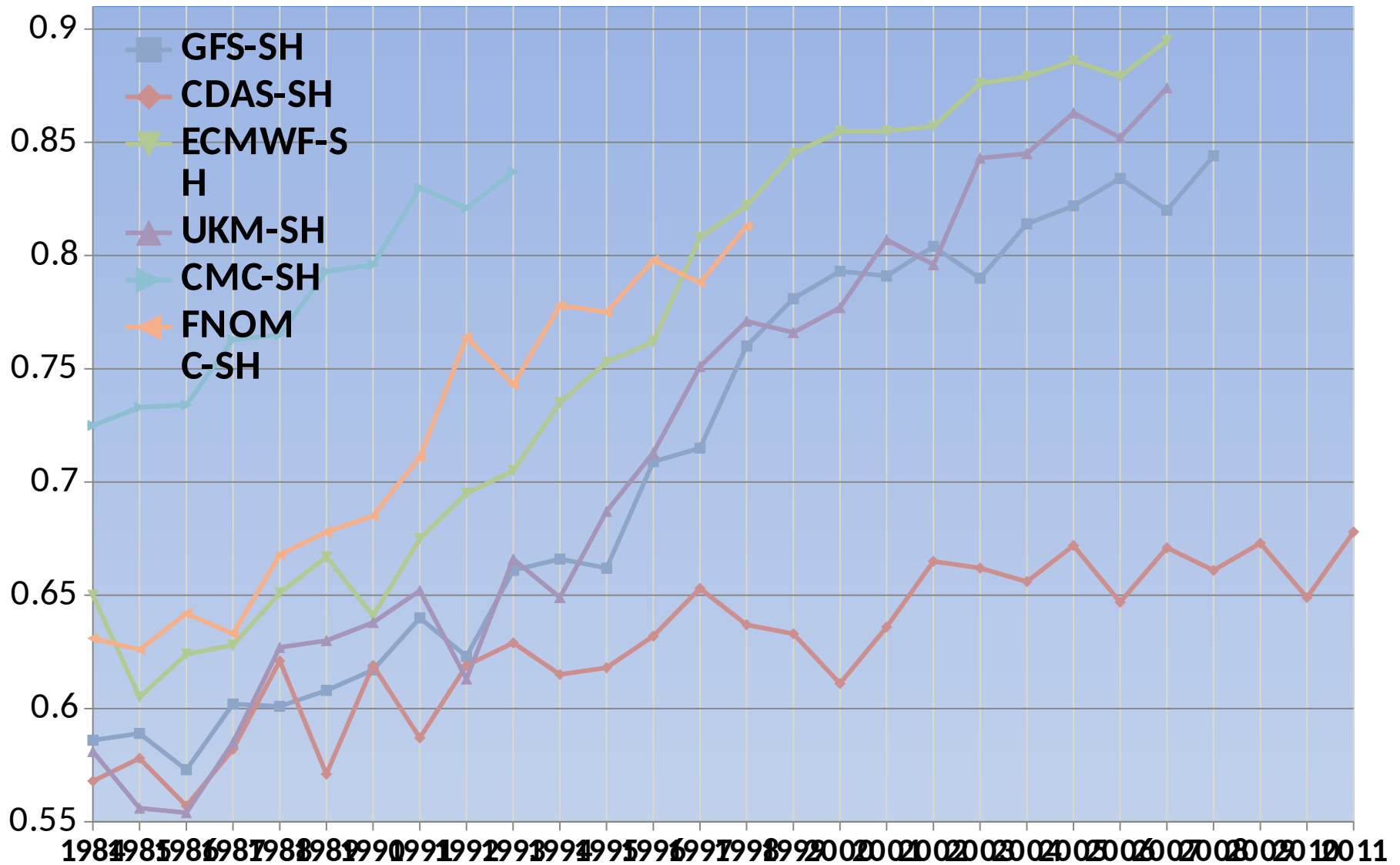


Annual Mean NH 500hPa HGT AC



FNOMC: little change from 2005 to 2009, large improvement after 2009

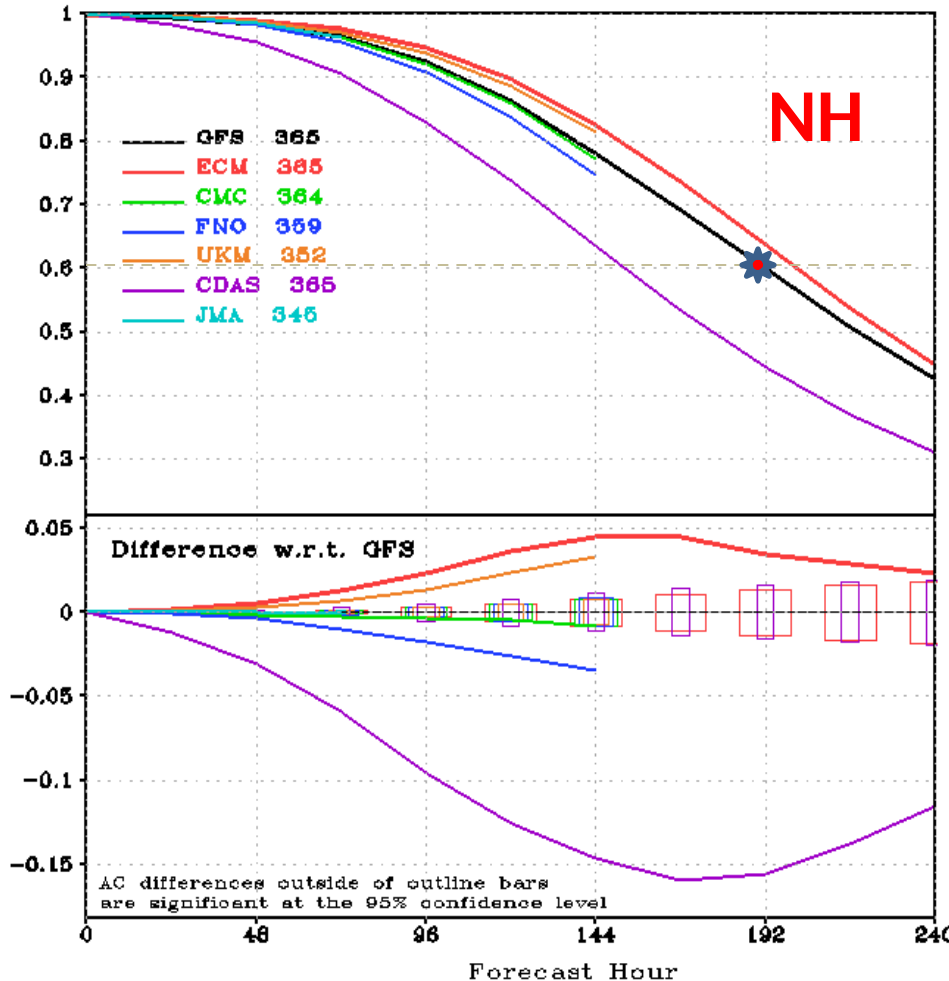
Annual Mean SH 500hPa HGT AC



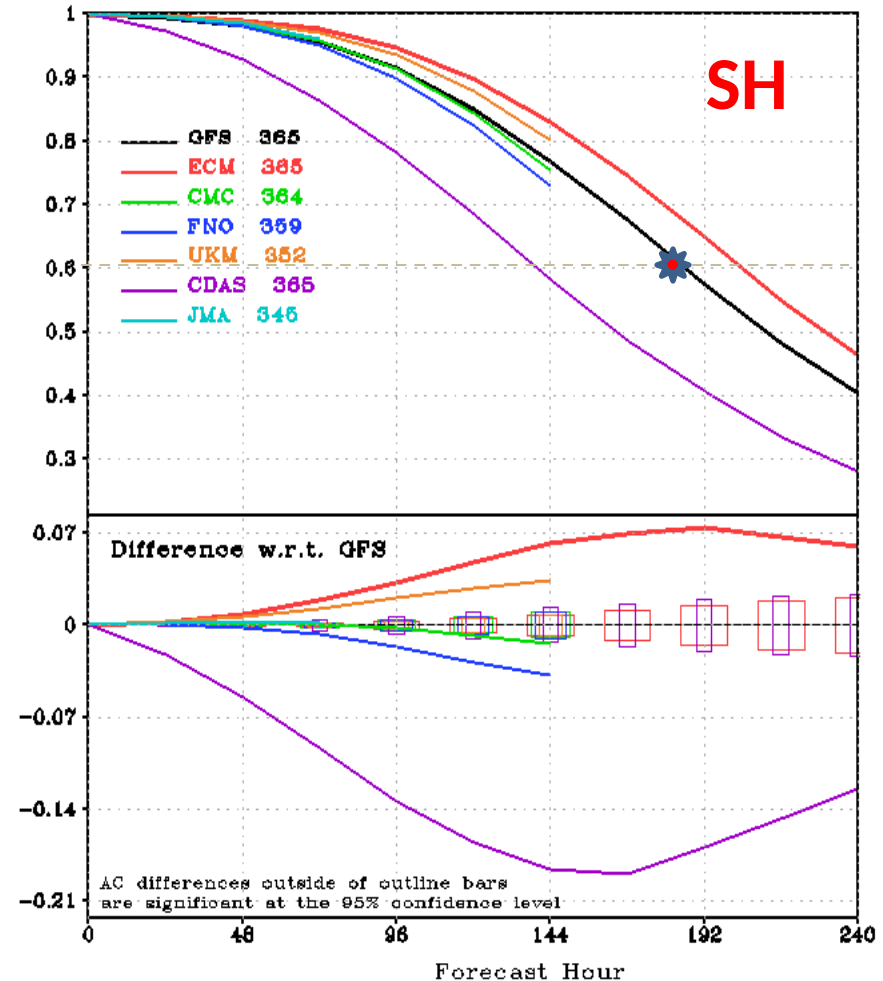
2011 Annual Mean 500hPa HGT AC

0.6 - useful
forecast

AC: HGT P500 Q2/NHX 00Z, 20110101-20111231

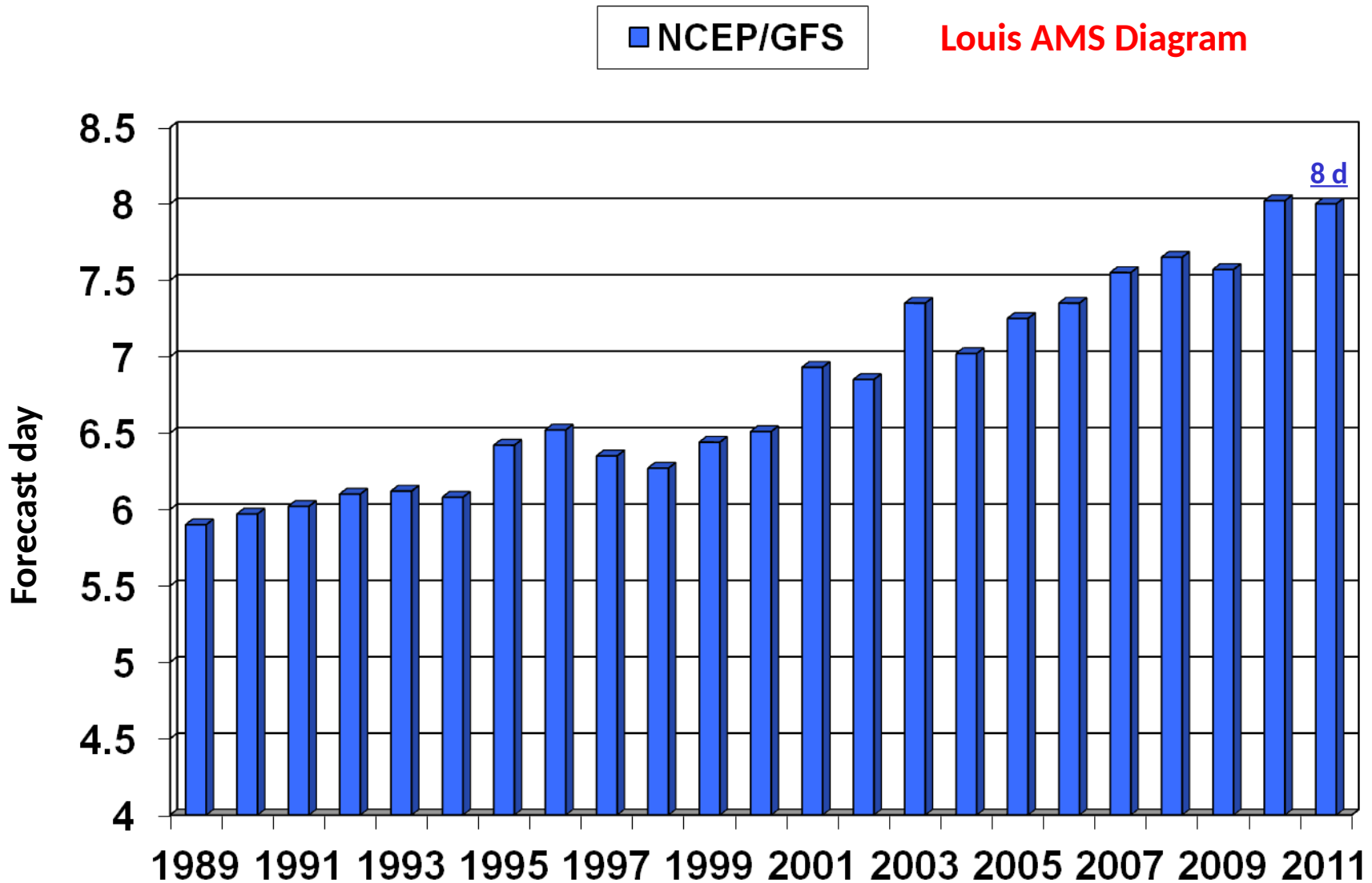


AC: HGT P500 Q2/SHX 00Z, 20110101-20111231

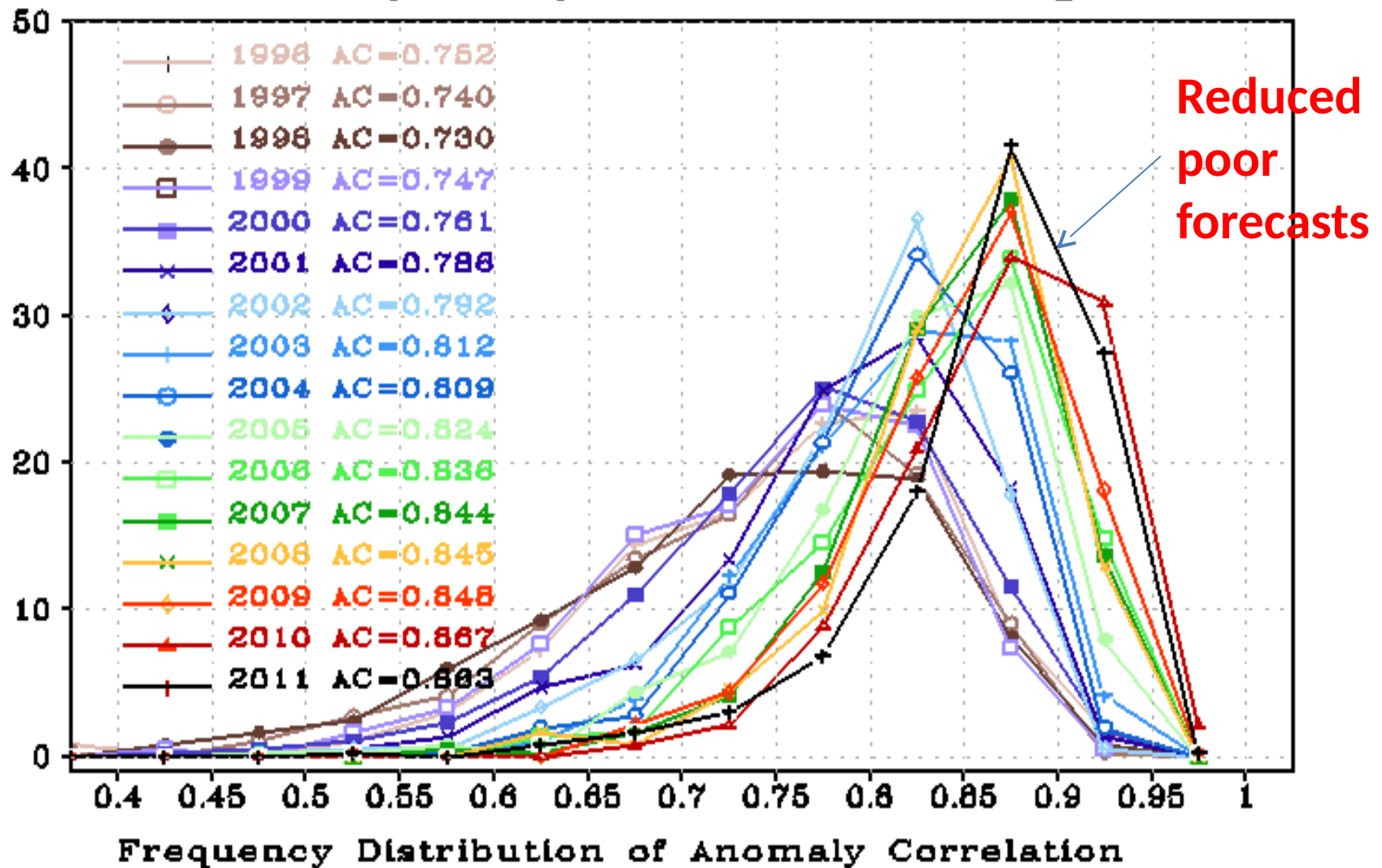


**GFS falls behind ECMWF and UKM, but is better than CMC, FNO and JMA.
GFS useful forecasts (>0.6) reached 8.0 days in the NH and 7.8 days in the SH.**

Day at which forecast loses useful skill (AC=0.6)
N. Hemisphere 500hPa height calendar year means



GFS 00Z—Cycle Day-5 Fcst, 500hPa Height, NH

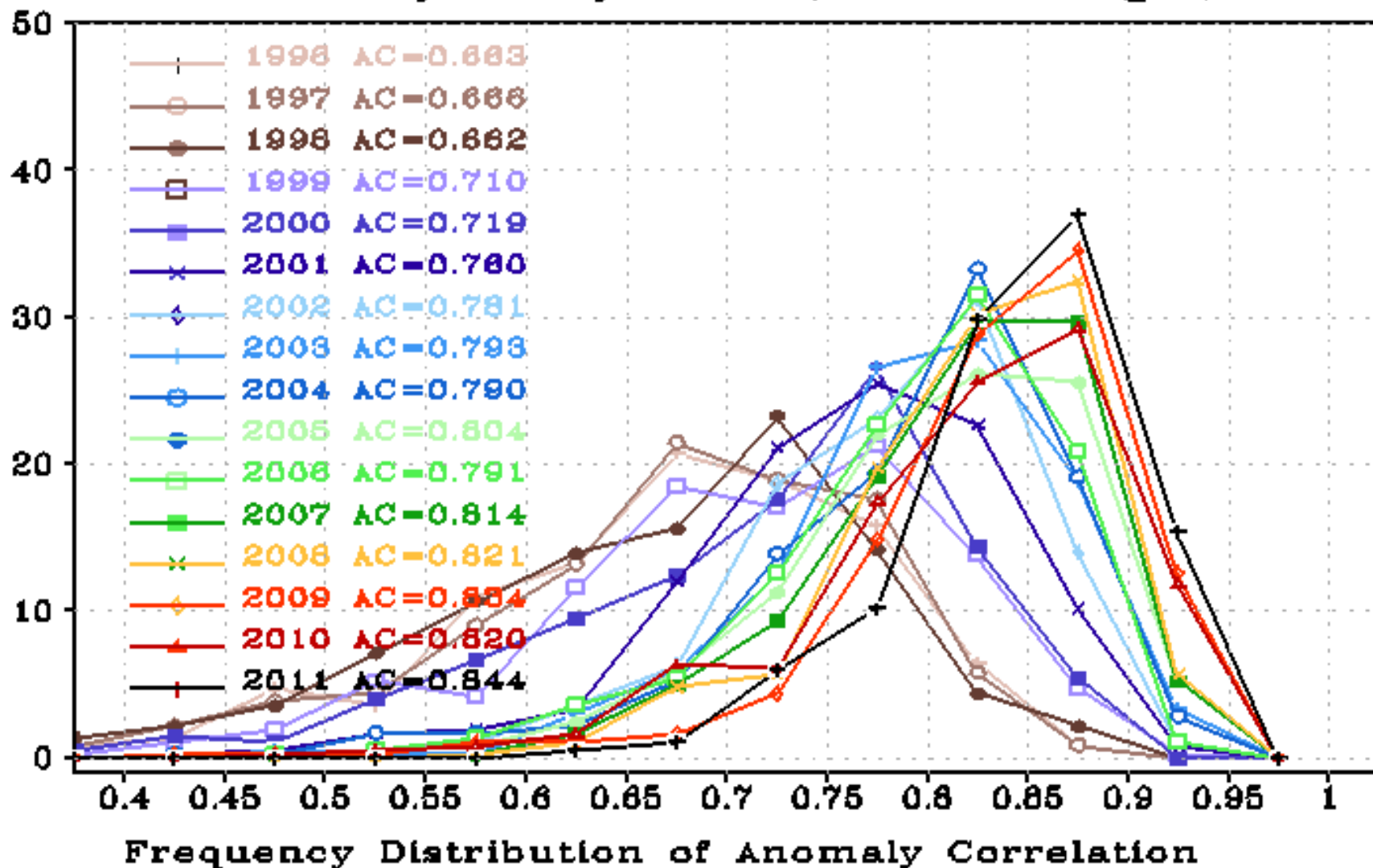


Look at the history of extremes in the distribution

- Poor Forecasts (AC < 0.7)
- Excellent forecasts (AC > 0.9)

Twenty bins were used to count for the frequency distribution, with the 1st bin centered at 0.025 and the last been centered at 0.975. The width of each bin is 0.05.

GFS 00Z-Cycle Day-5 Fcst, 500hPa Height, SH

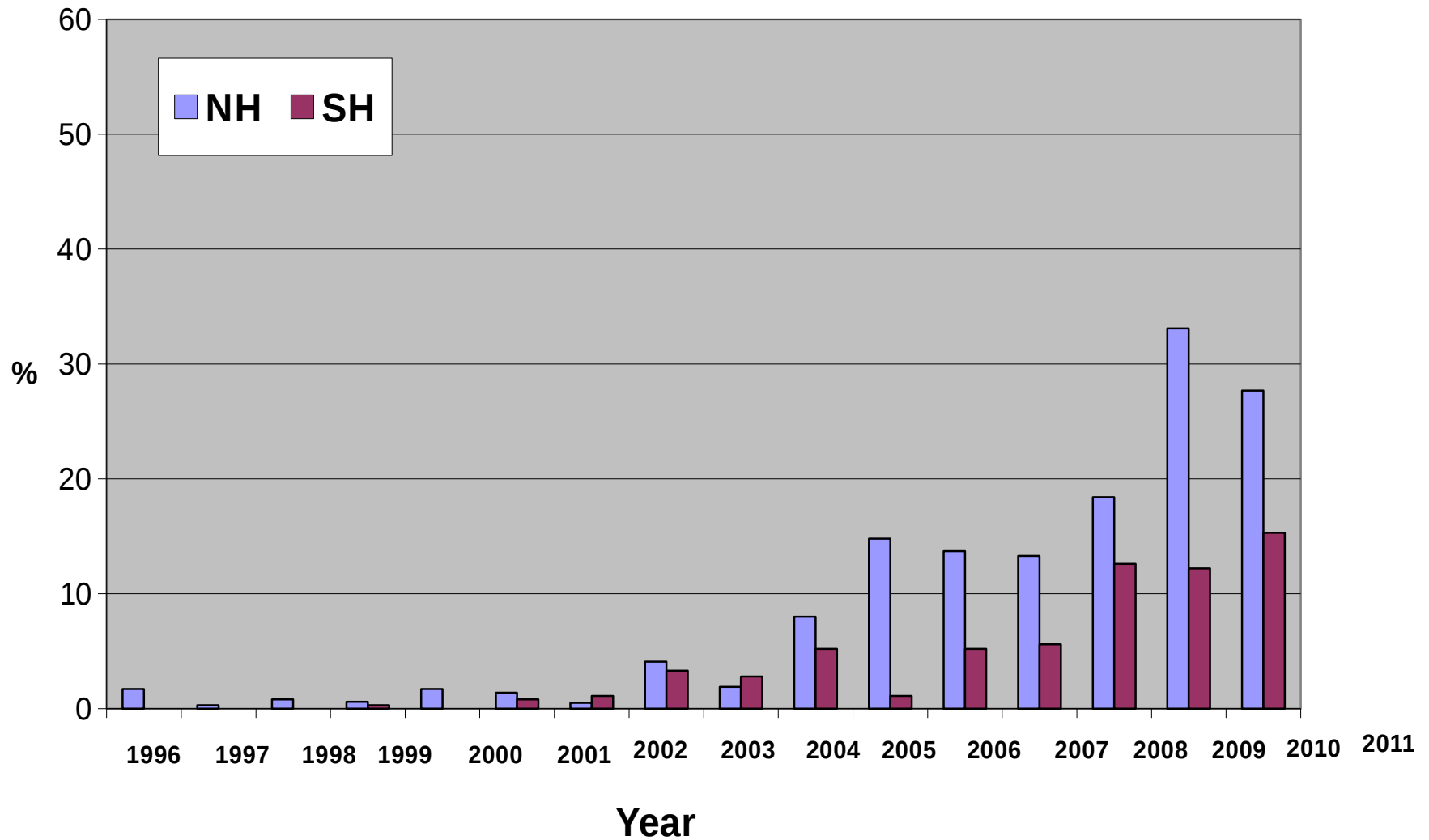


Look at the history of extremes in the distribution

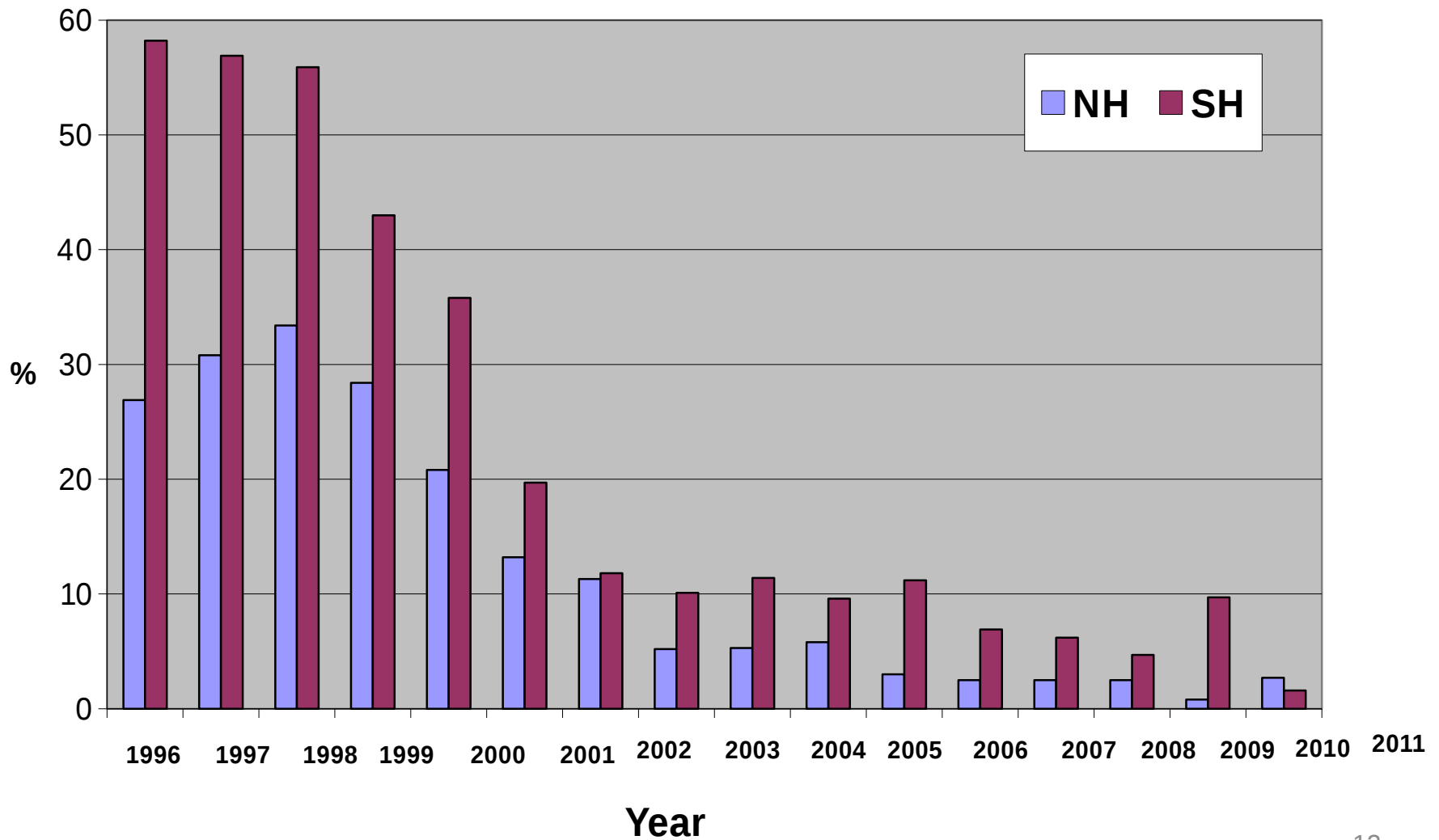
- Poor Forecasts ($AC < 0.7$)
- Excellent forecasts ($AC > 0.9$)

Twenty bins were used to count for the frequency distribution, with the 1st bin centered at 0.025 and the last been centered at 0.975. The width of each bin is 0.05.

Percent of Excellent Forecasts (AC > 0.9)

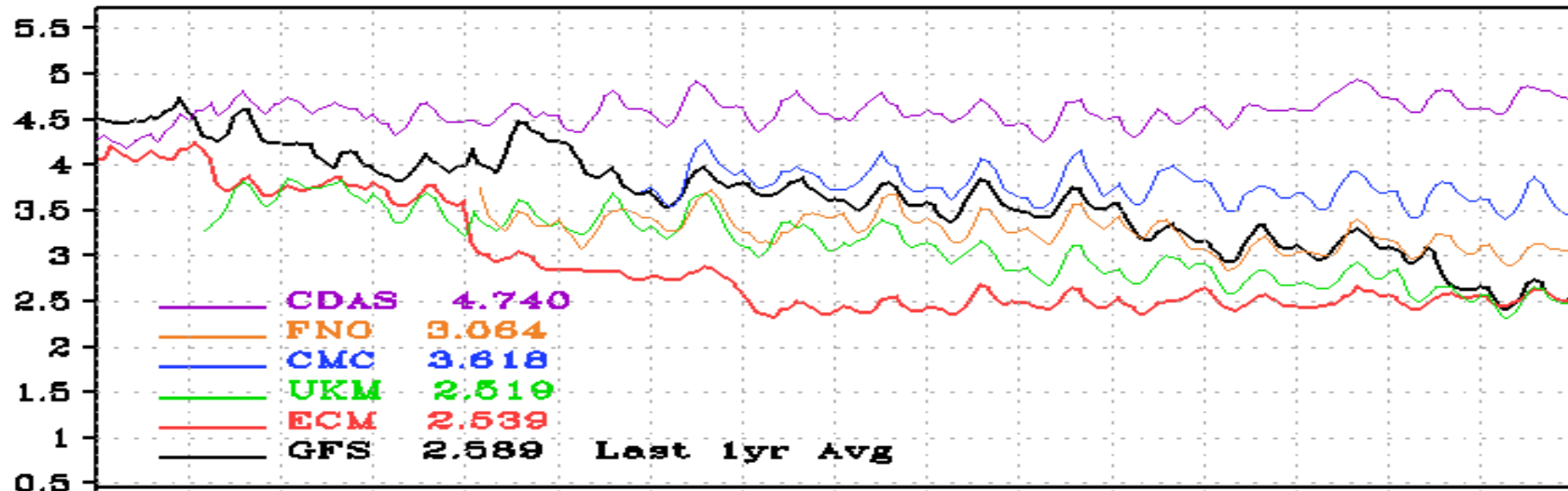


Percent of Poor Forecasts ($AC < 0.7$)

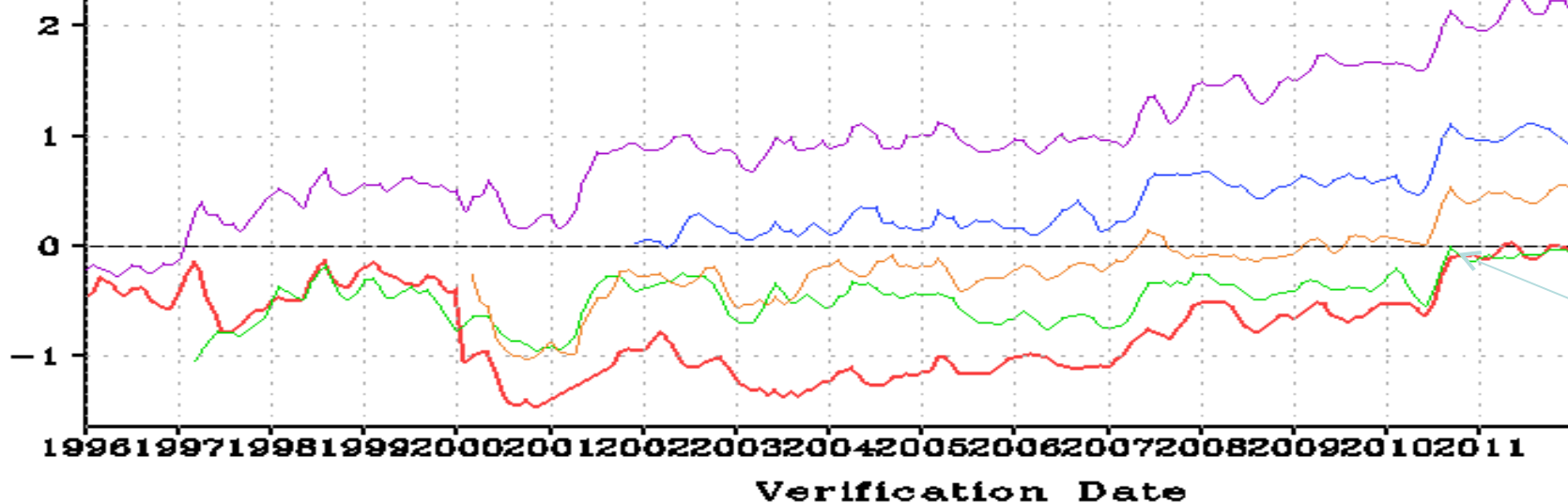


Tropical Wind RMSE, 850-hPa Day-3 Forecast

Tropic Vector Wind RMSE: 850hPa Day3. 3-Mon Mean

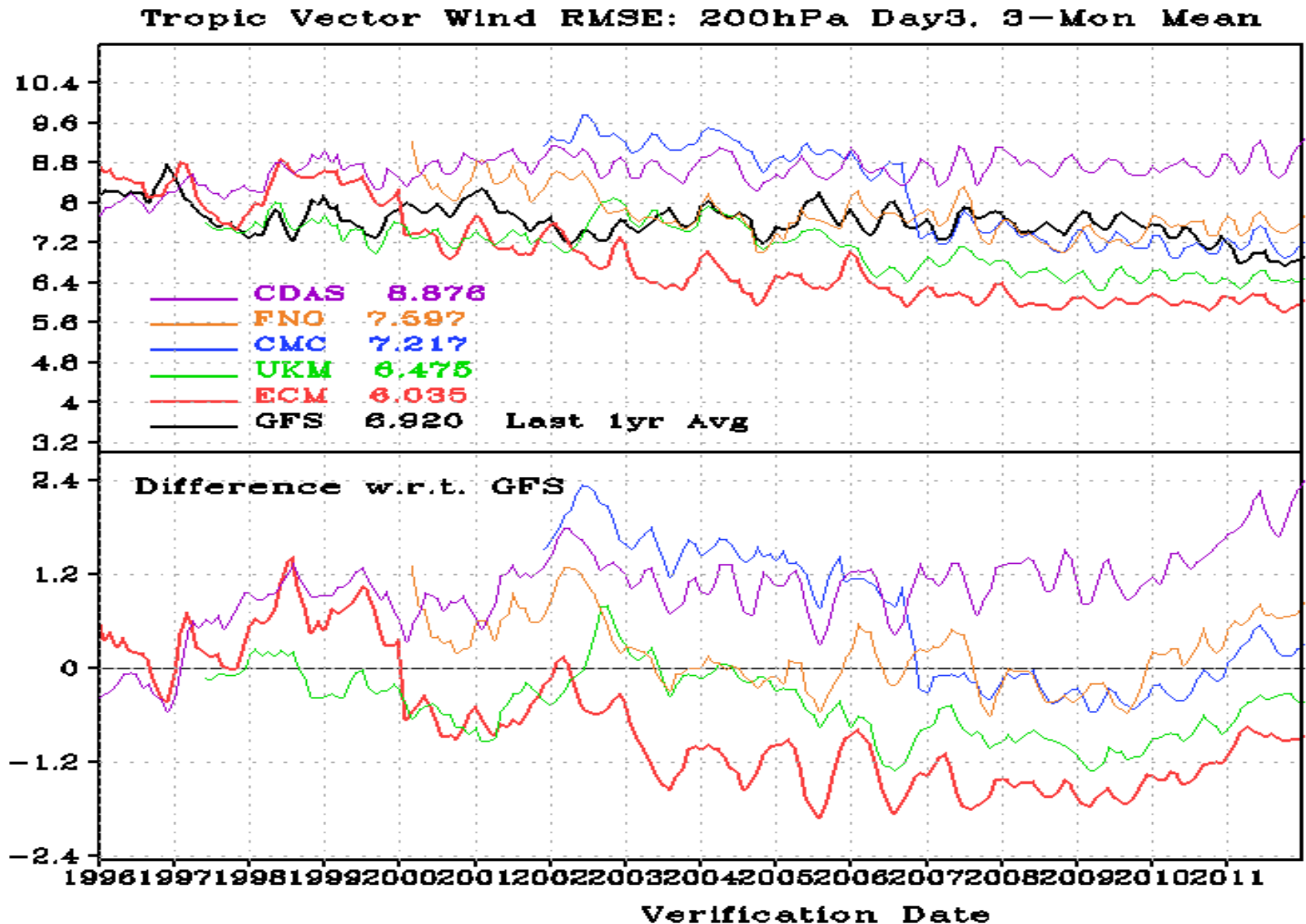


Difference w.r.t. GFS



July 2010 T574 GFS Implementation

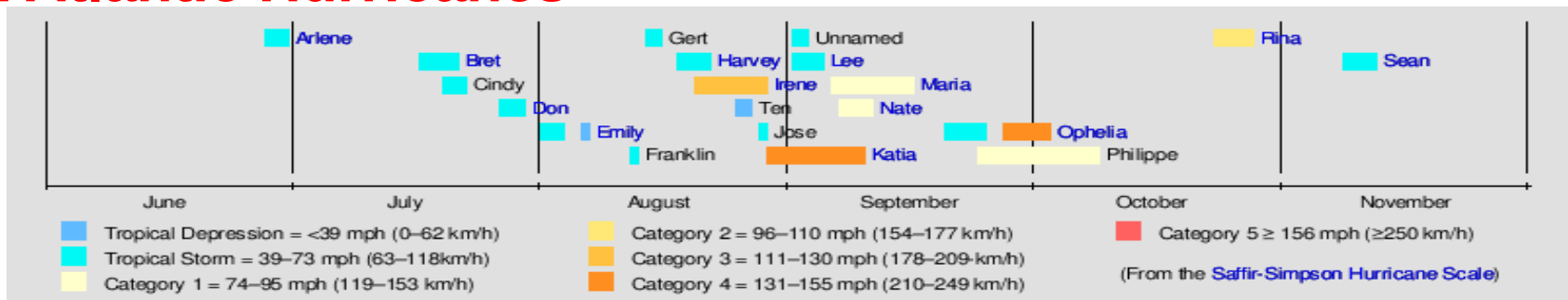
Tropical Wind RMSE, 200-hPa Day-3 Forecast



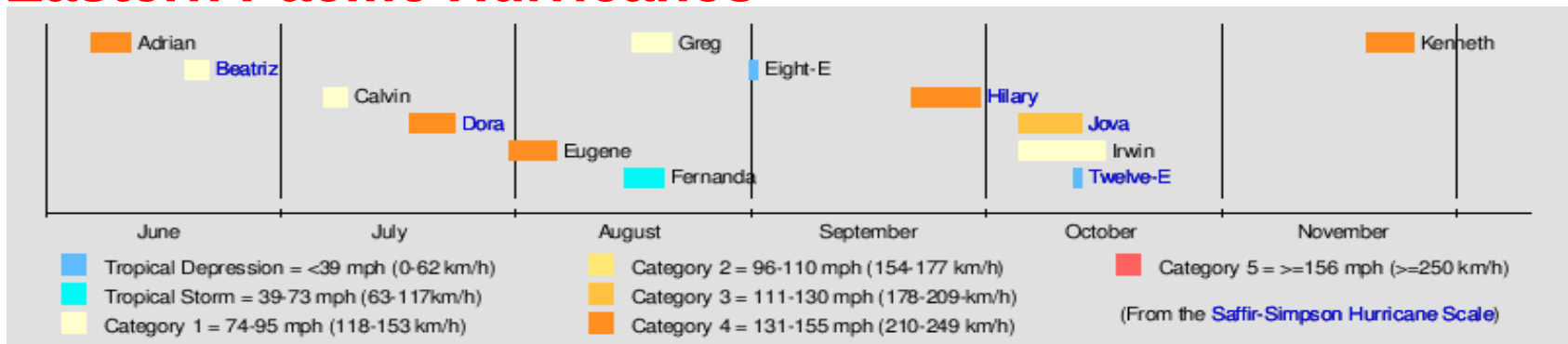
Major International NWP Models

2011 Hurricane Track and Intensity Forecast Errors

2011 Atlantic Hurricanes



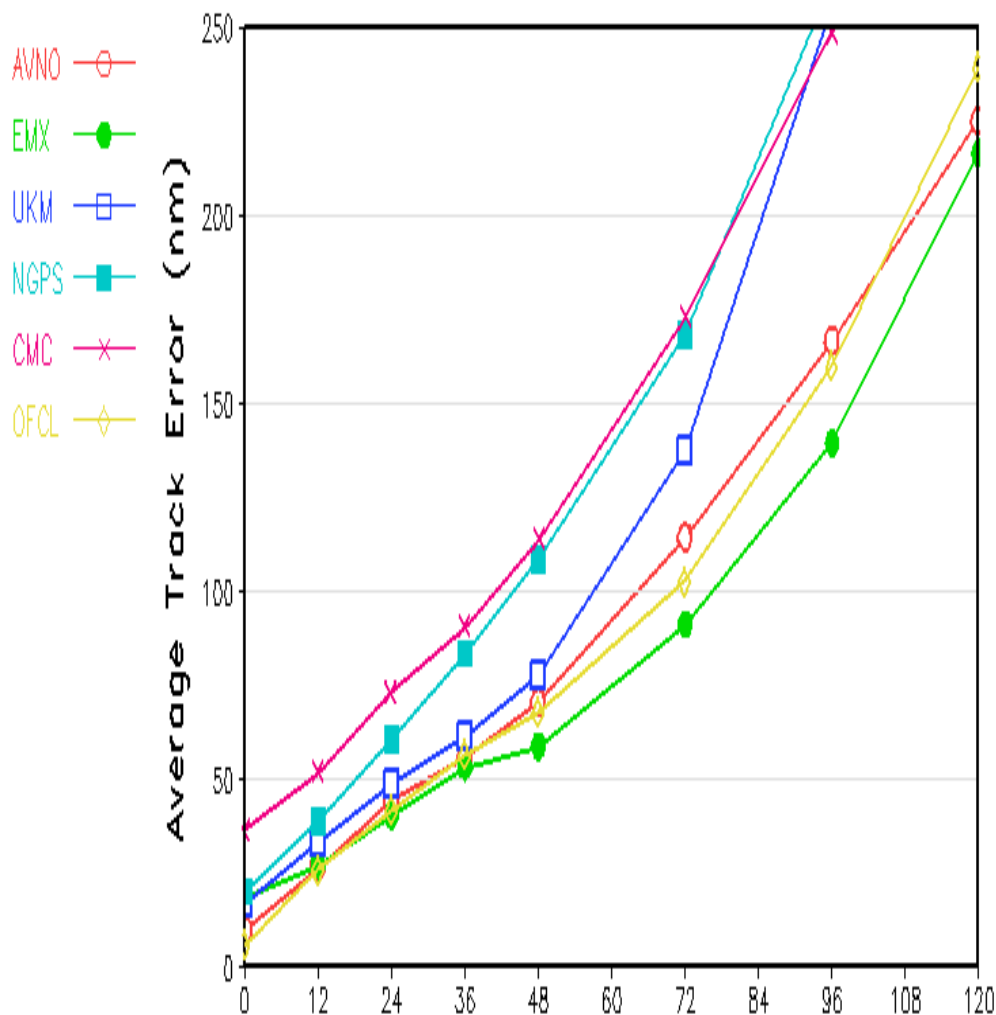
2011 Eastern Pacific Hurricanes



2011 Atlantic Hurricane Track and Intensity Errors

Hurricane Track Errors – Atlantic 2011

20110401_20111231_2cyc



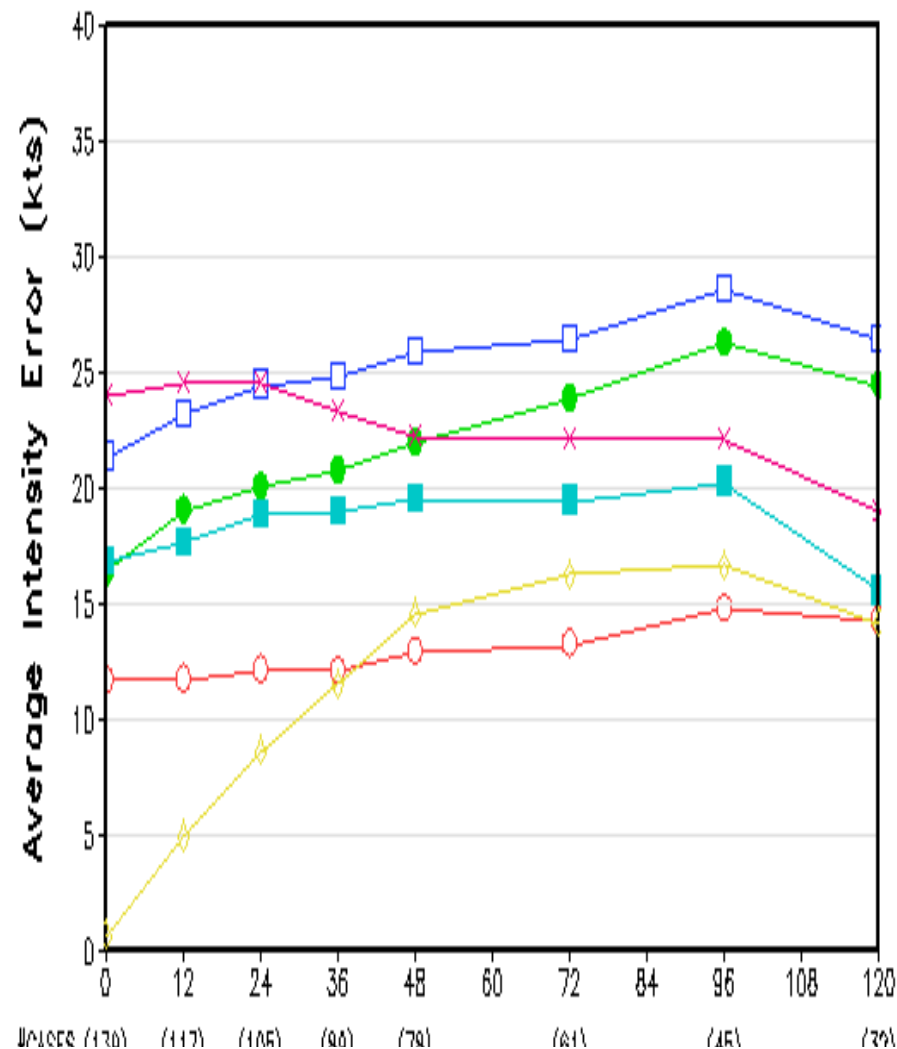
AVNO = GFS

EMX = ECMWF

00Z and 12Z cycles

Hurricane Intensity Errors – Atlantic 2011

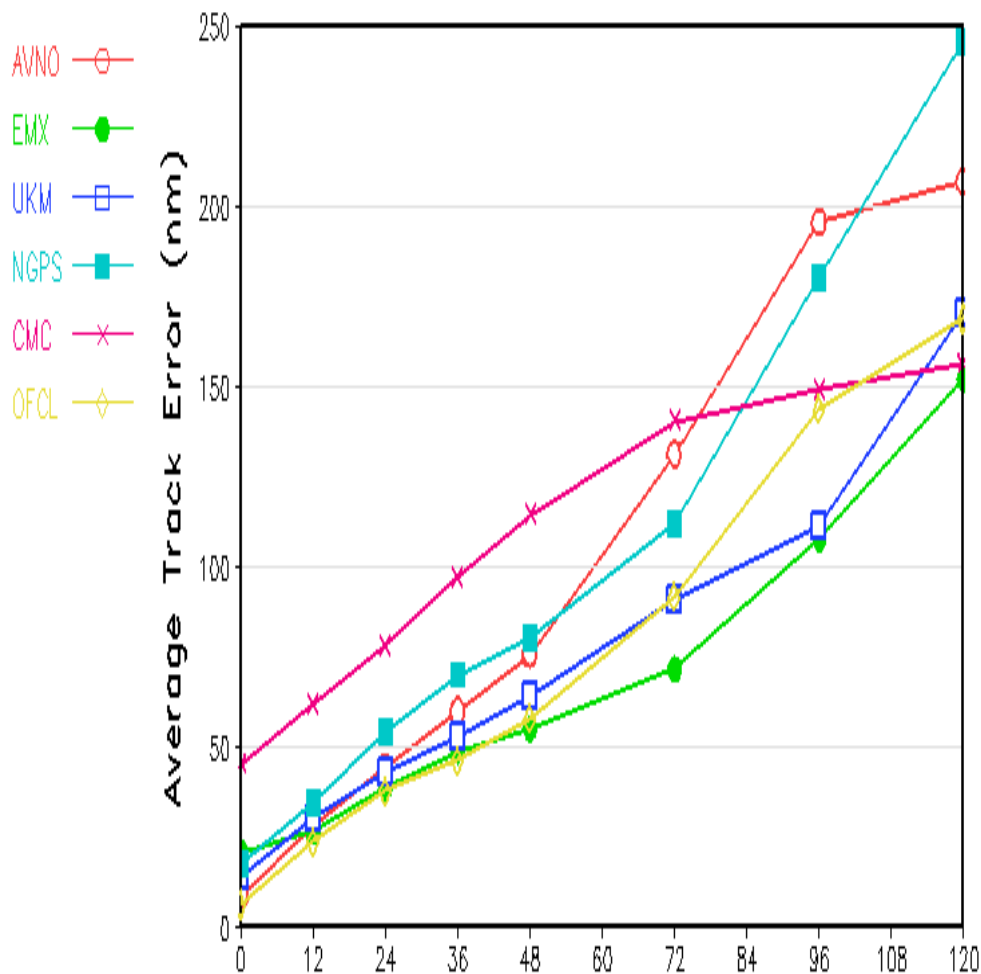
20110601_20111025_2cyc



2011 Eastern Pacific Hurricane Track and Intensity Errors

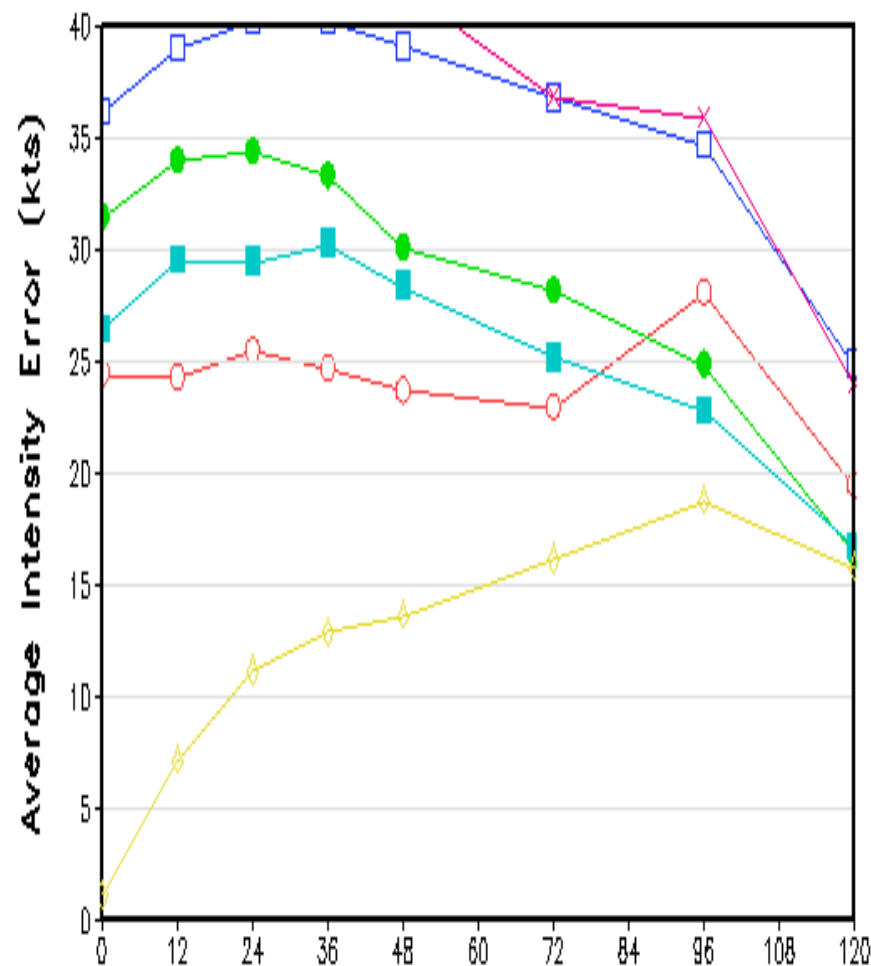
Hurricane Track Errors - East-Pacific 2011

20110401_20111231_2cyc



Hurricane Intensity Errors - East-Pacific 2011

20110401_20111231_2cyc



AVNO = GFS

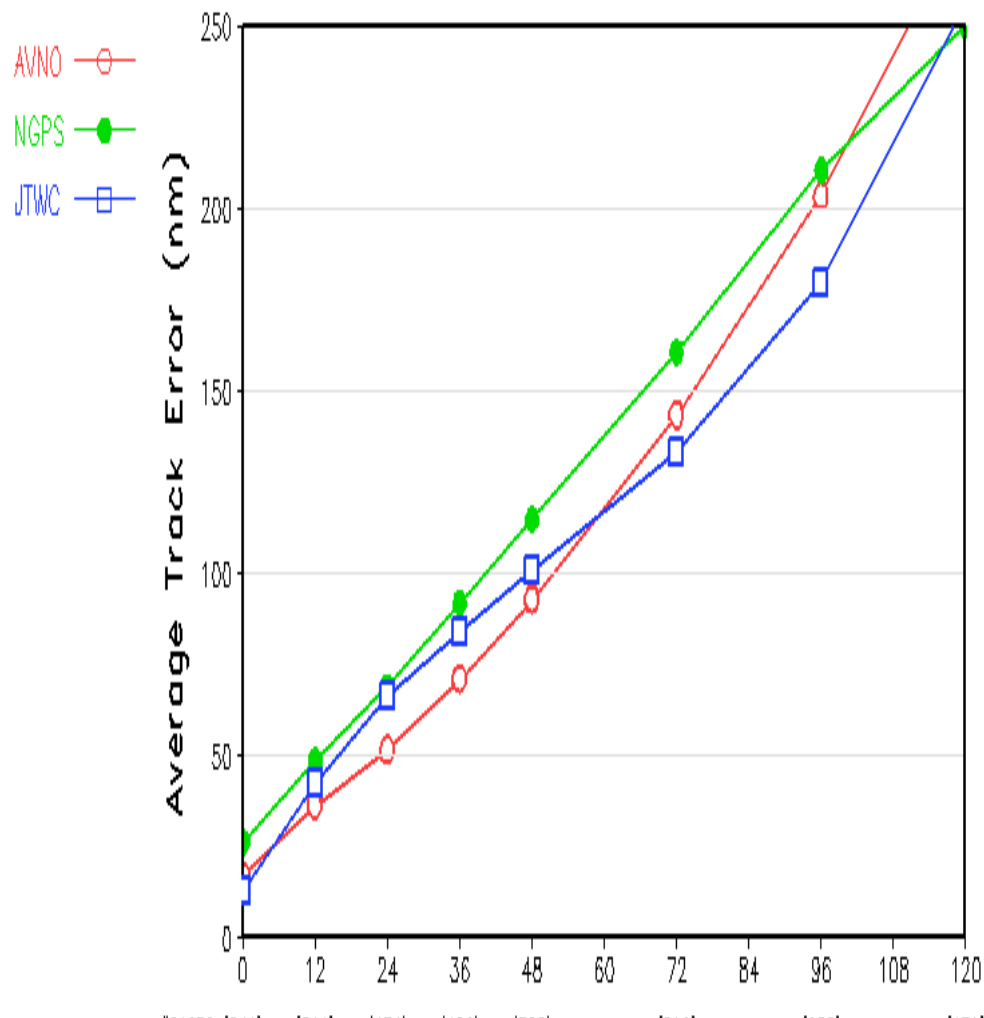
EMX = ECMWF

00Z and 12Z cycles

2011 Western Pacific Hurricane Track and Intensity Errors

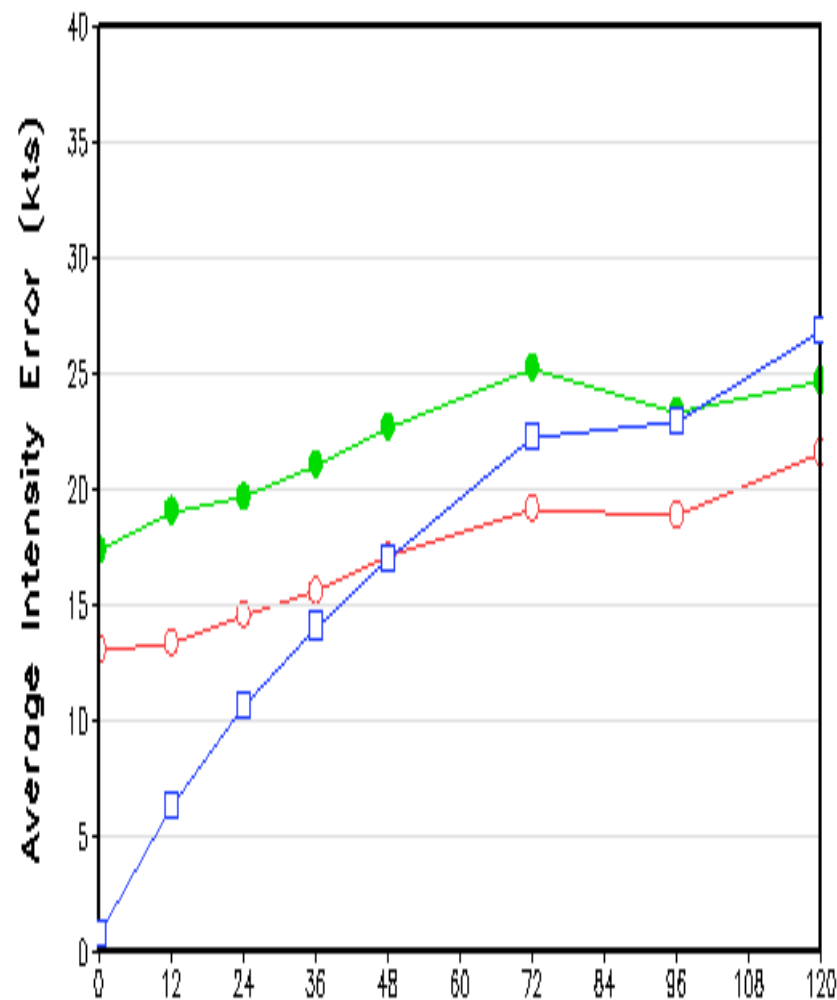
Hurricane Track Errors - West-Pacific 2011

20110401_20111231_2cyc



Hurricane Intensity Errors - West-Pacific 2011

20110401_20111231_2cyc



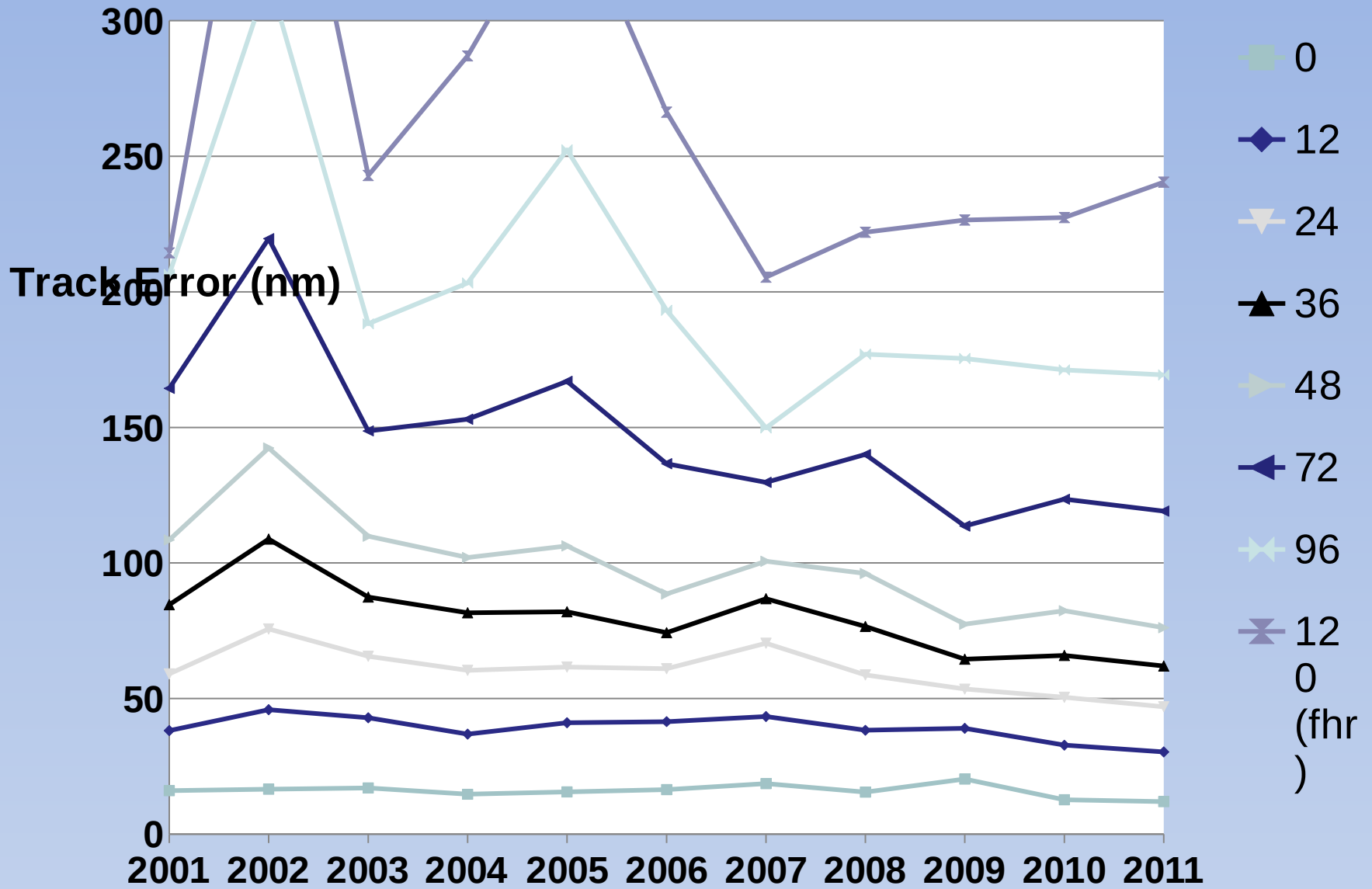
AVNO = GFS

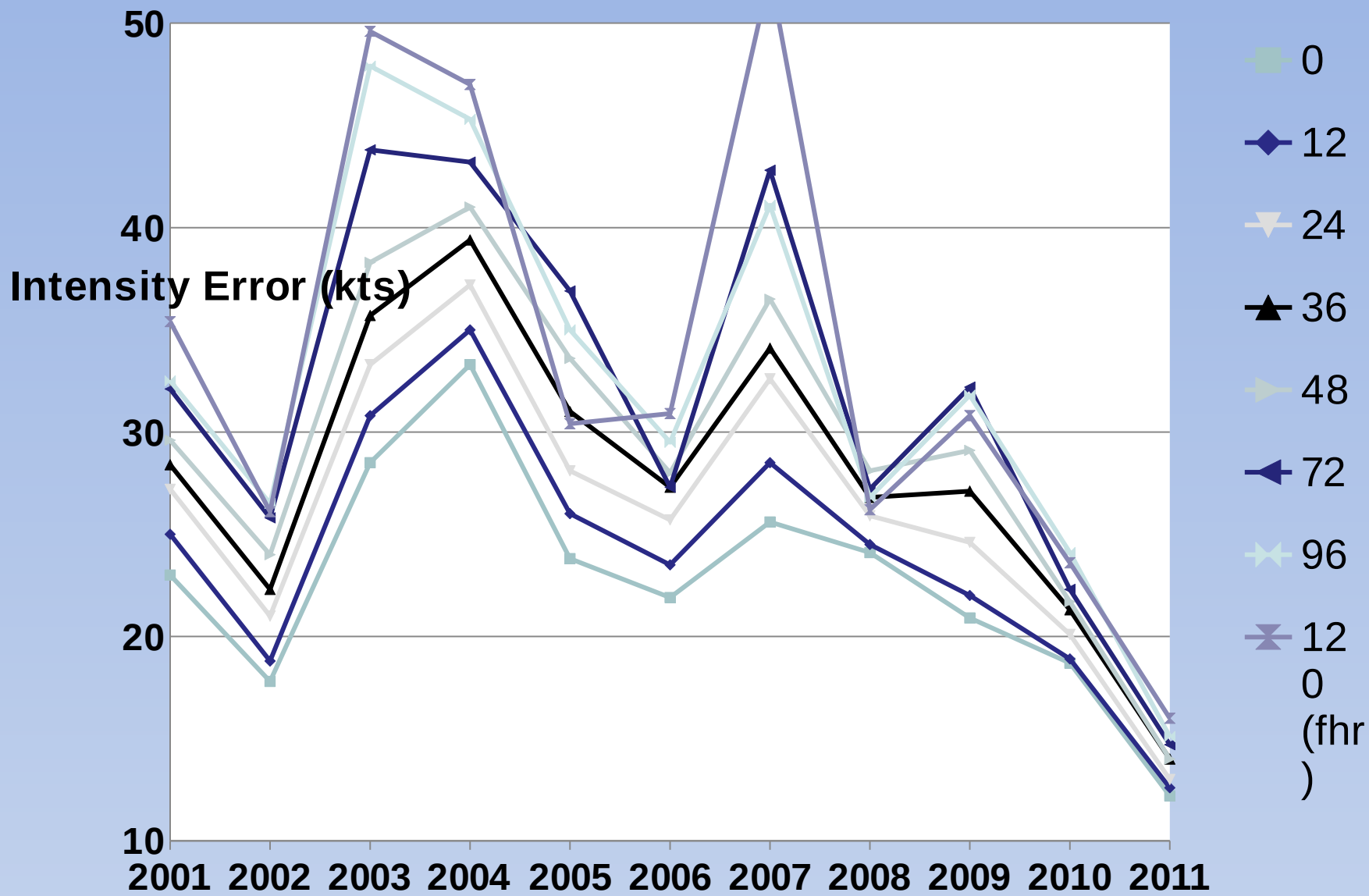
EMX = ECMWF

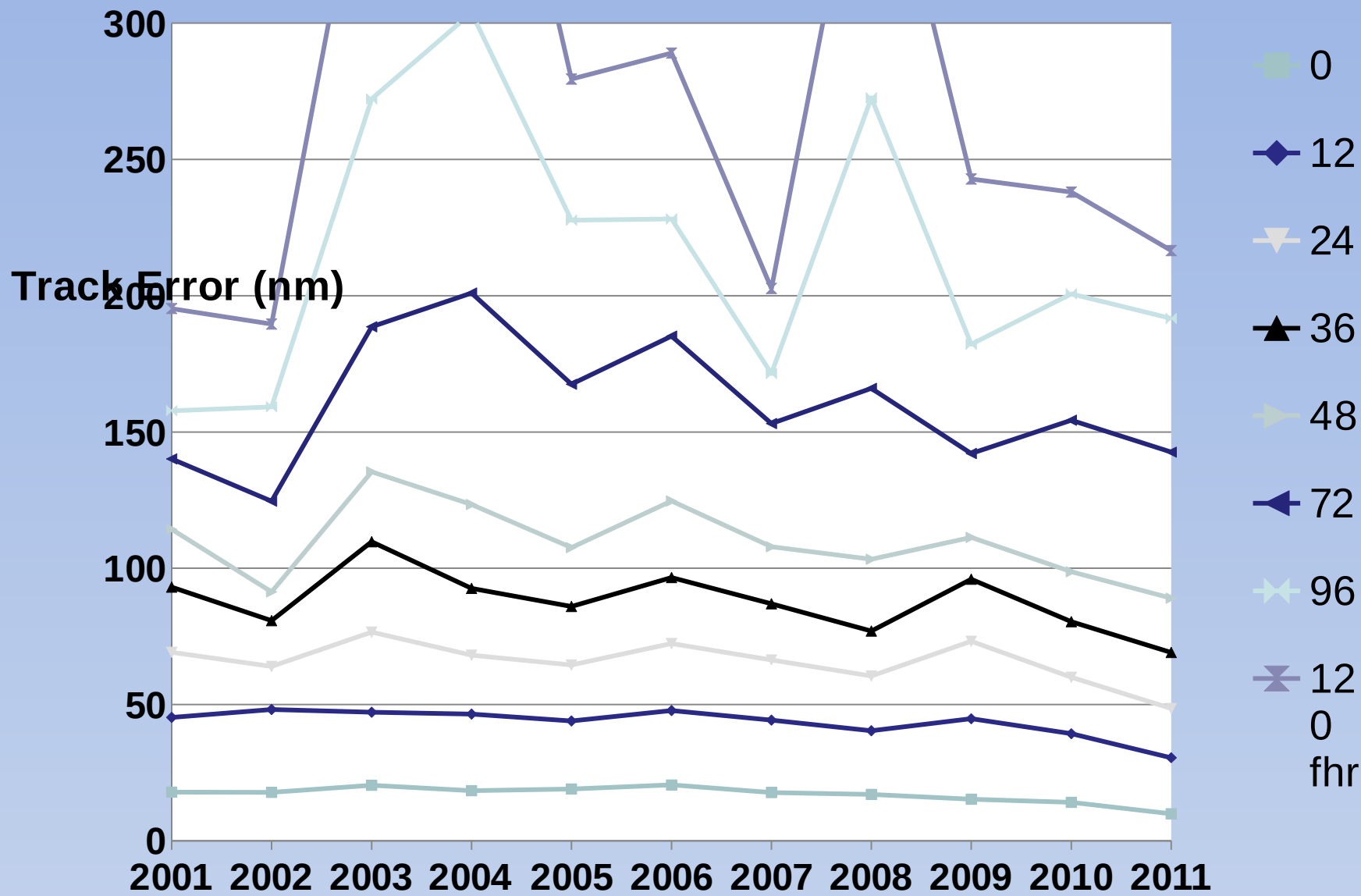
00Z and 12Z cycles

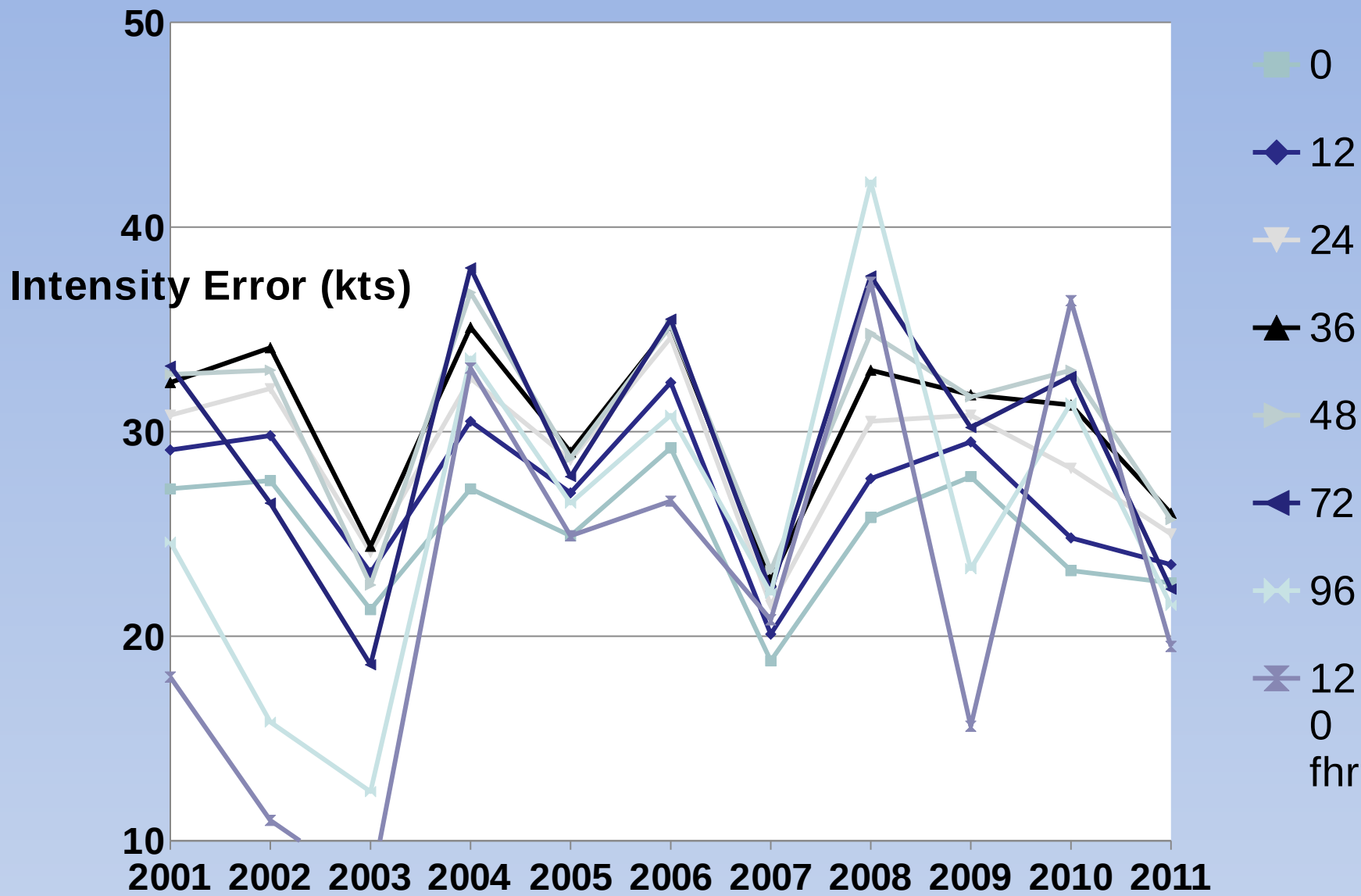
Hurricane Track and Intensity Forecast Errors

NCEP GFS : 2001 ~ 2011





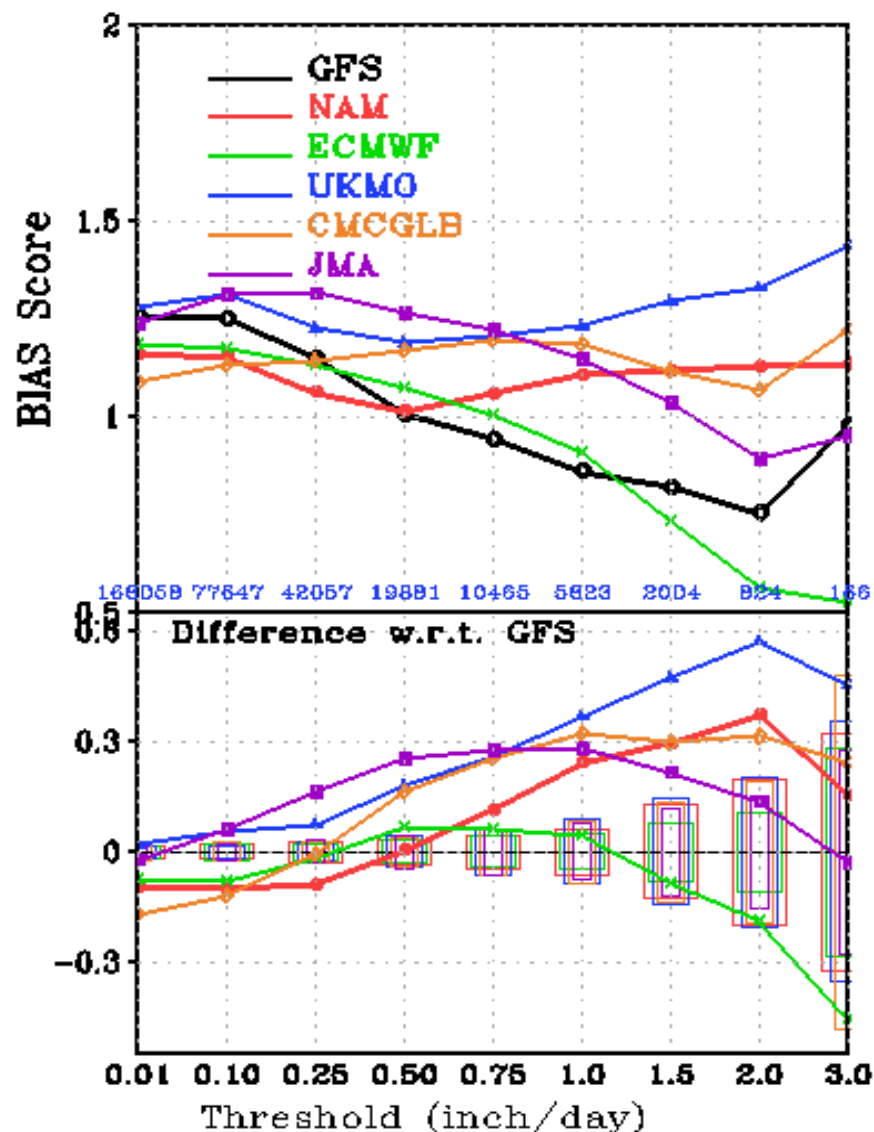
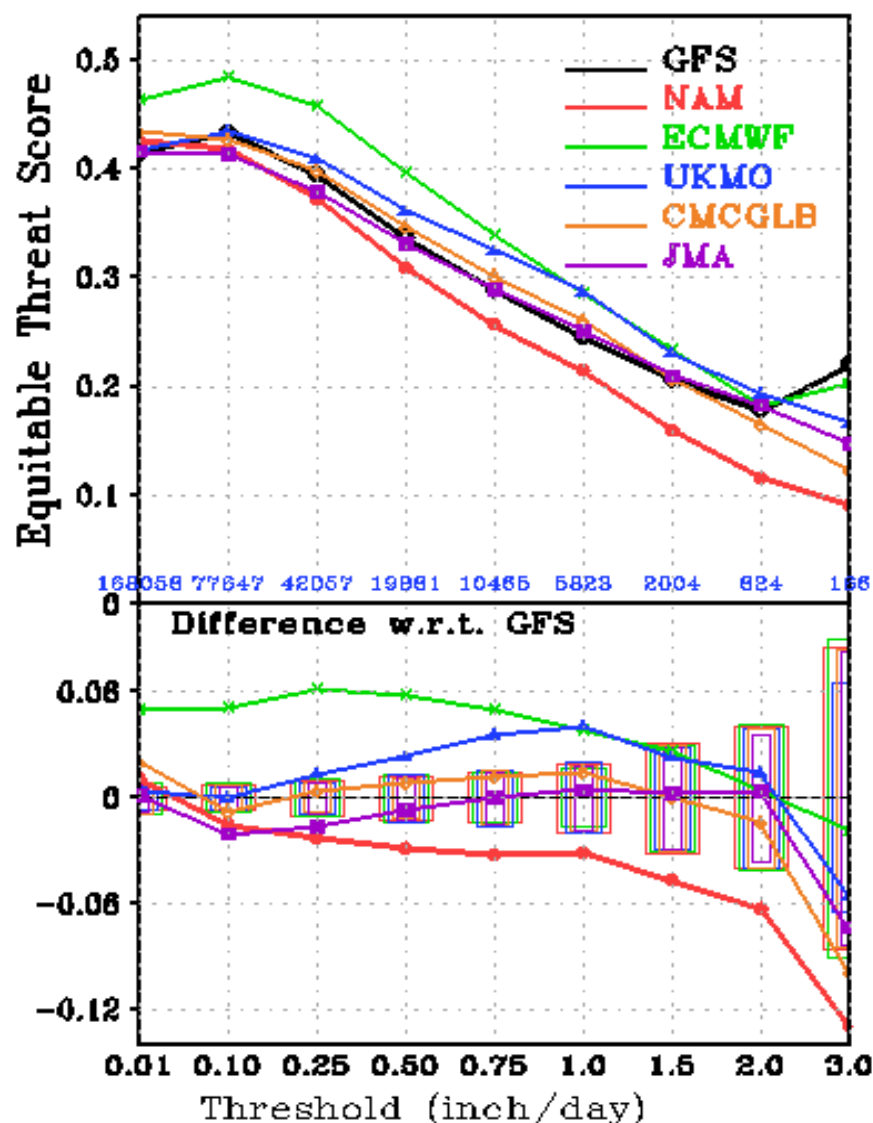




2011 CONUS Precipitation Forecast Threat Skill Scores

CONUS Precipitation, Day-2 Forecast

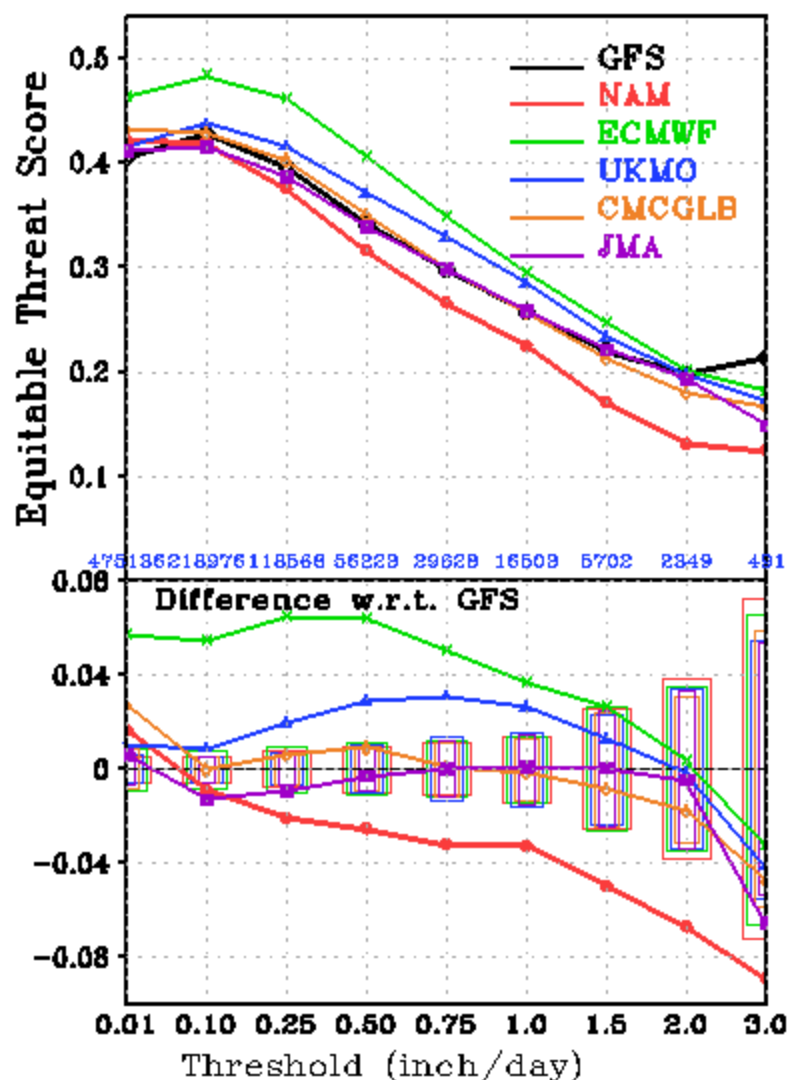
CONUS Precip Skill Scores, fh24-fh48, 31dec2010-31dec2011



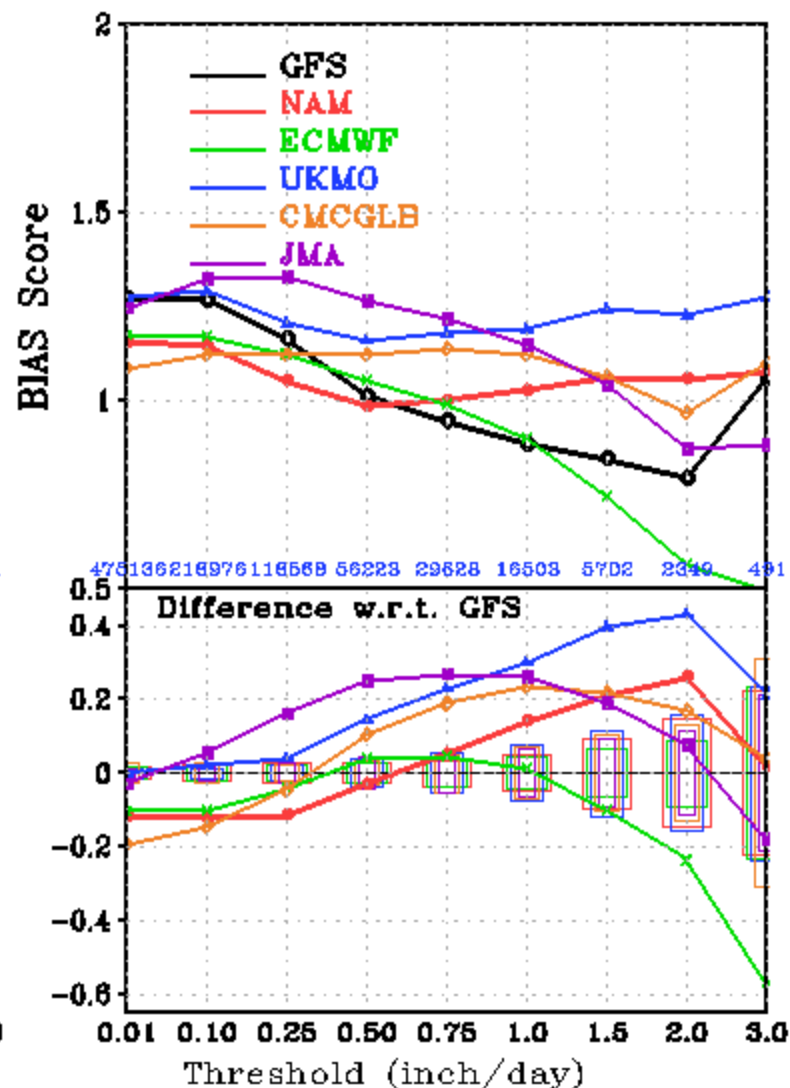
Differences outside of the hollow bars are 95% significant based on 10000 Monte Carlo Tests

CONUS Precipitation, 0-72hr Total

CONUS Precip Skill Scores, fh00-fh72, 31dec2010-31dec2011



Differences outside of the hollow bars are 95% significant based on 10000 Monte Carlo Tests



2011

**A Year with Record-Breaking
Billion-Dollar Weather Disasters**

2011: A Year with Record-Breaking Billion-Dollar Weather Disasters



29Jan ~ 2Feb: Groundhog Day Blizzard: \$2 billion

Blizzards, ice storms, snow storms brought major U.S. cities to a standstill, **killed 36** people, caused \$2 billion in damages. Maximum snowfall 27 inches.

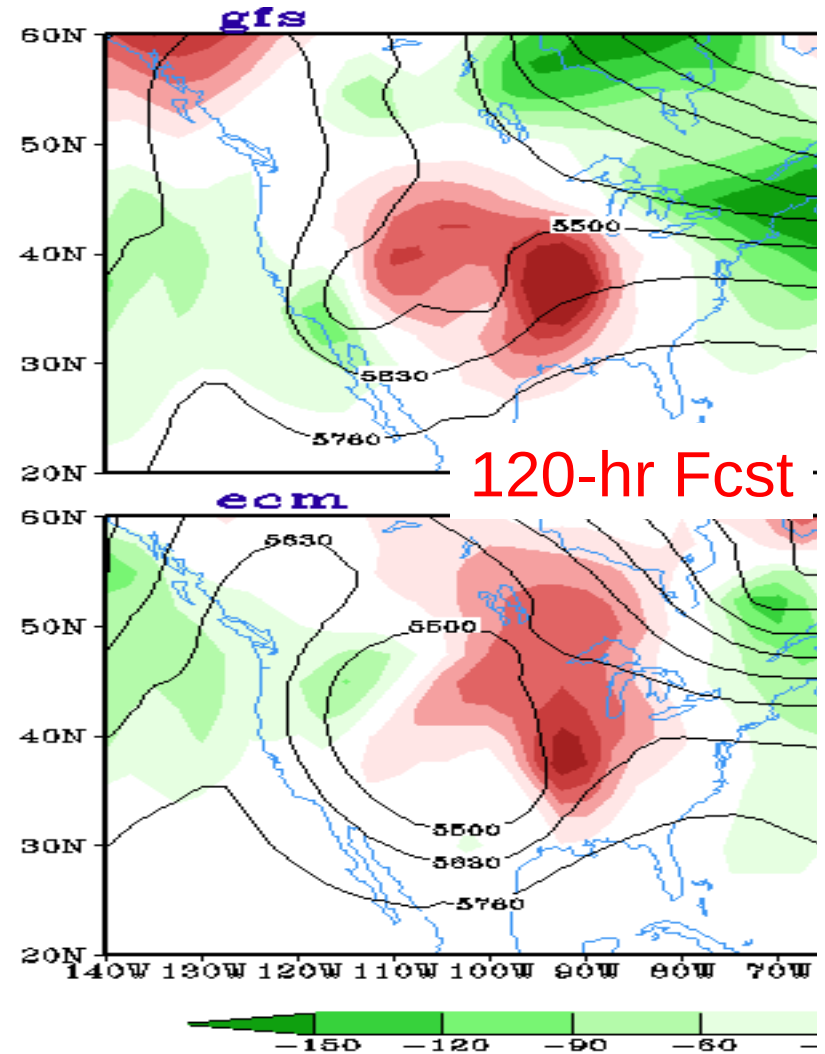
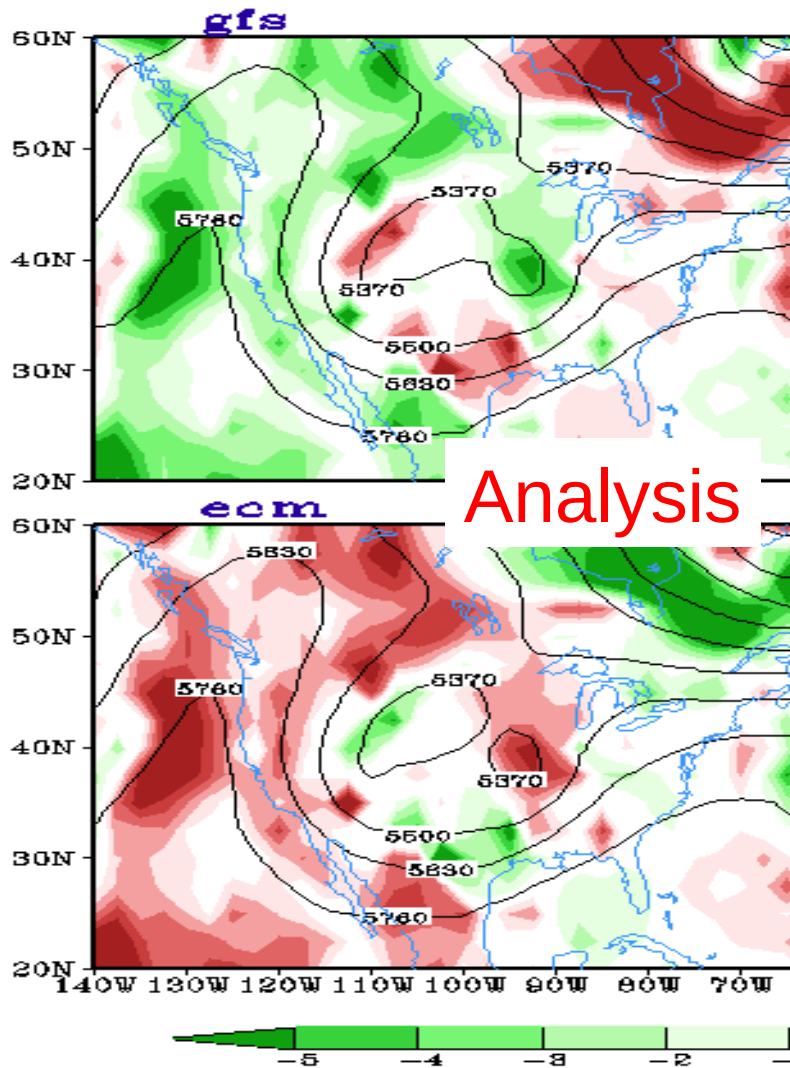


<http://www.wikipedia.org>

<http://www.thedailygreen.com/>

500 hPa Height Valid for 00Z 02Feb2011

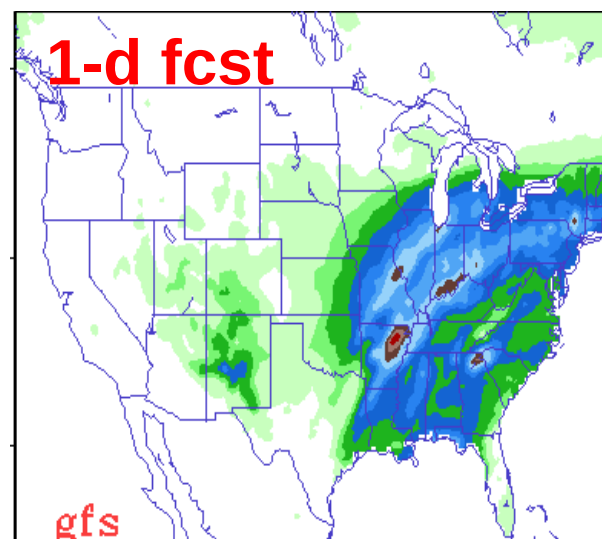
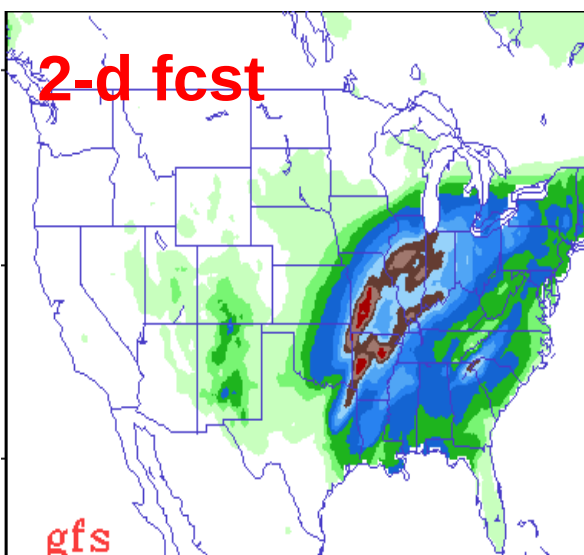
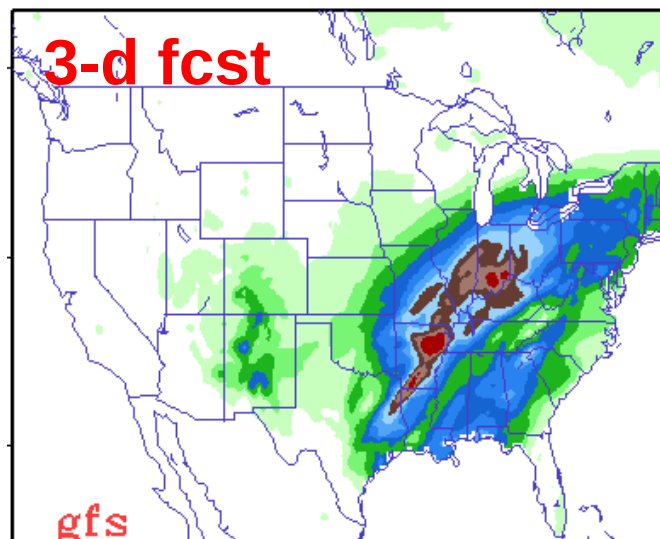
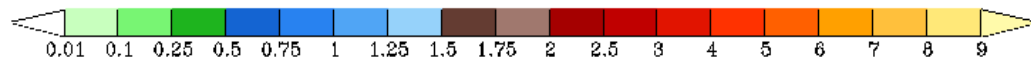
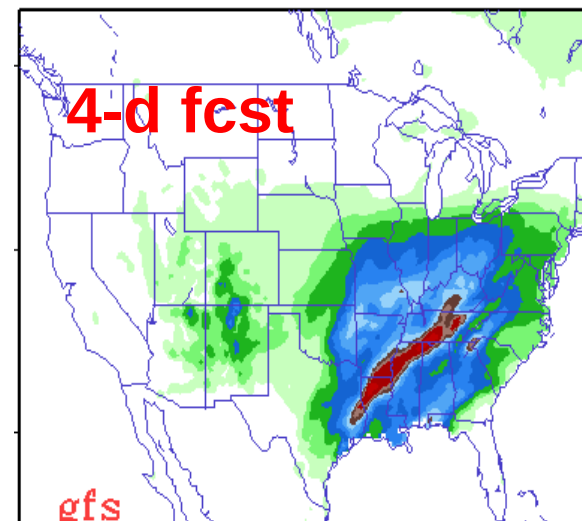
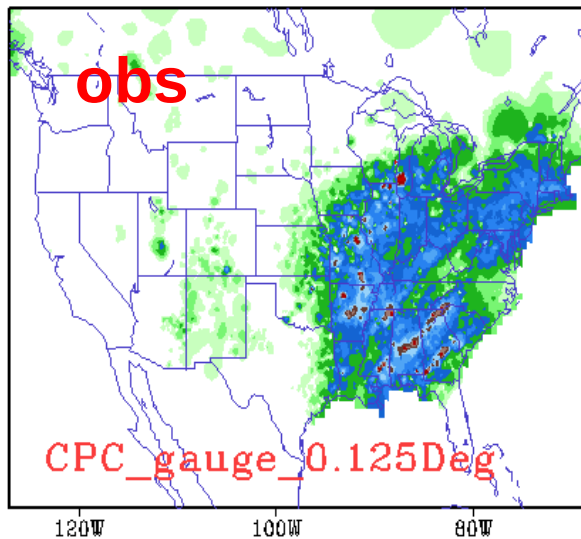
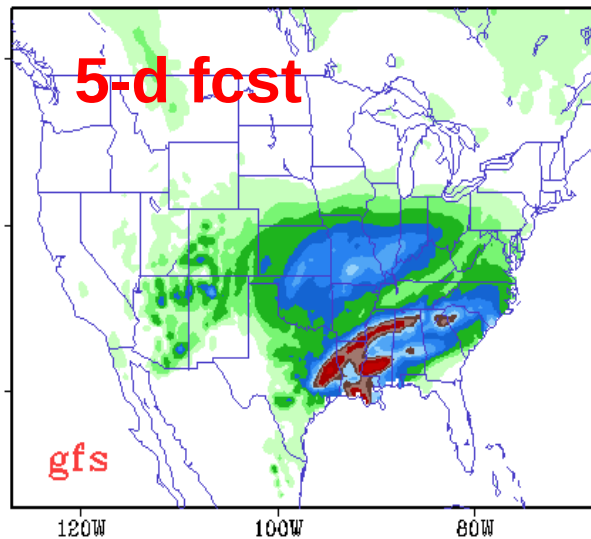
GFS and ECMWF Analyses and Forecasts



Both models predicted quite well the system

GFS Rainfall Forecast, 24hr Accumulation Ending at 12Z02Feb2011

24-Hr Accumulated Precip (inch) Valid: 2011020112 - 2011020212
108hr to 132hr Forecast from Cycle 2011012800



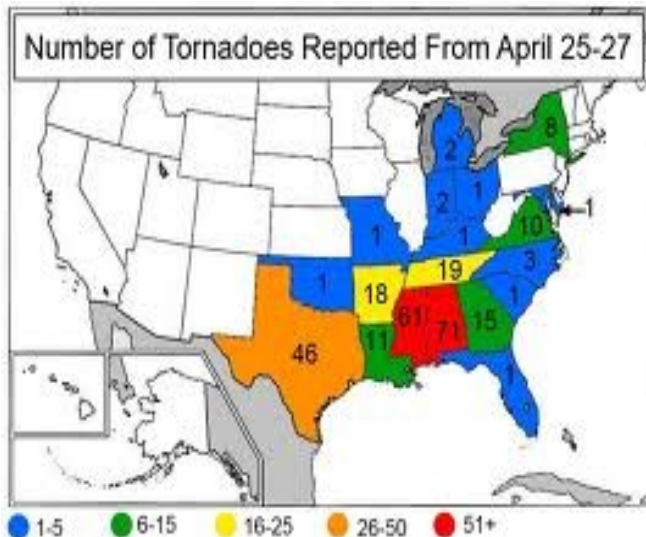
2011: A Year with Record-Breaking Billion-Dollar Weather Disasters



Tornado Outbreaks: 22 billion

1,559 confirmed tornadoes, killed at least **550 people** in the US (compared to 564 deaths in the 10 years prior combined).

1. April 4-5: 46 tornadoes in the Midwest and Southeast.
2. April 8-11, ~ 60 tornadoes in the central and southern US.
3. April 14-16: ~ 160 tornadoes in the southern and central U.S.
4. April 25-30: ~ 305 tornadoes ripped through the Southeast, Midwest and Ohio Valley, killing 327 people.
5. May 22-27: 180 tornadoes killed 177, most of them in Joplin, Mo.

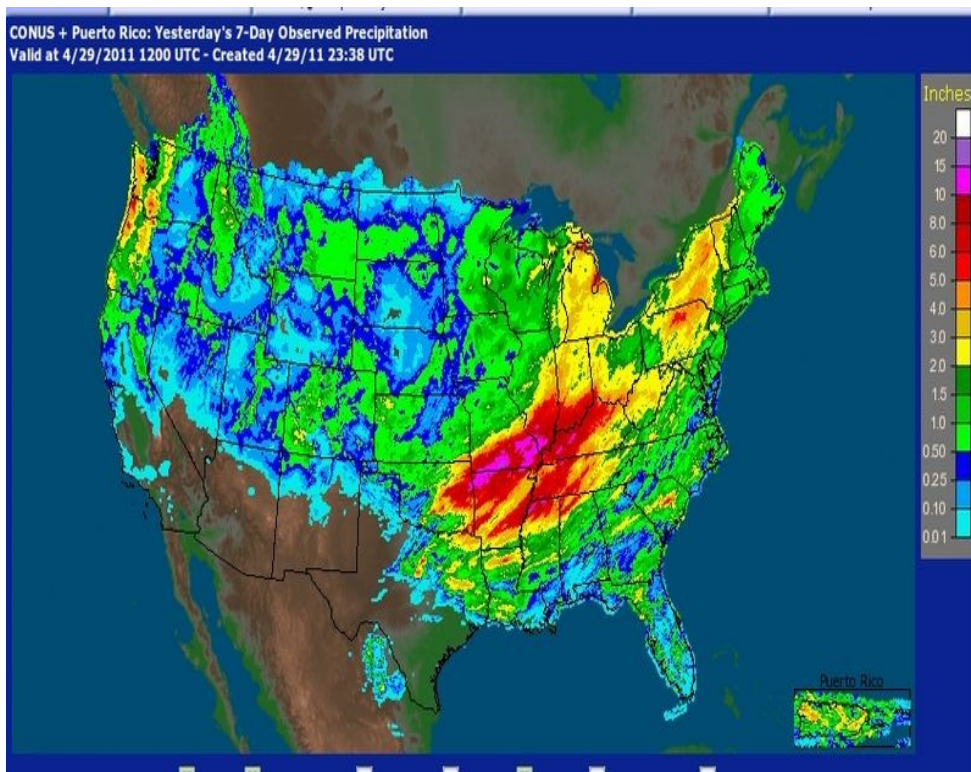


2011: A Year with Record-Breaking Billion-Dollar Weather Disasters



Mississippi River Flooding: \$2-4 Billion

The Mississippi River floods in **April and May 2011** were among the largest and most damaging recorded along the U.S. waterway in the past century, comparable in extent to the major floods of **1927** and **1993**, led to at 20 deaths and a cost of between \$3 and \$5 billion.

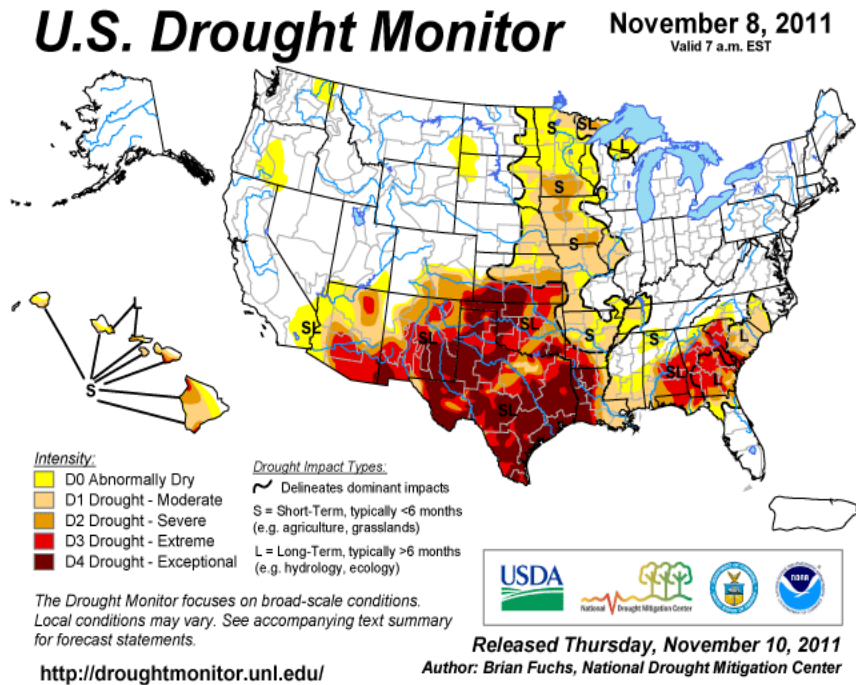


Rainfall totals for the week ending April 29.

2011: A Year with Record-Breaking Billion-Dollar Weather Disasters

Southern U.S. Drought: \$5 Billion

A historic drought centered on Texas, the driest 12-month (Oct-Sept) period in Texas since **1895**. Ruined a majority of crops and cost \$1 million a day in wildfire-fighting costs. The disaster's cost was more than \$5 billion.

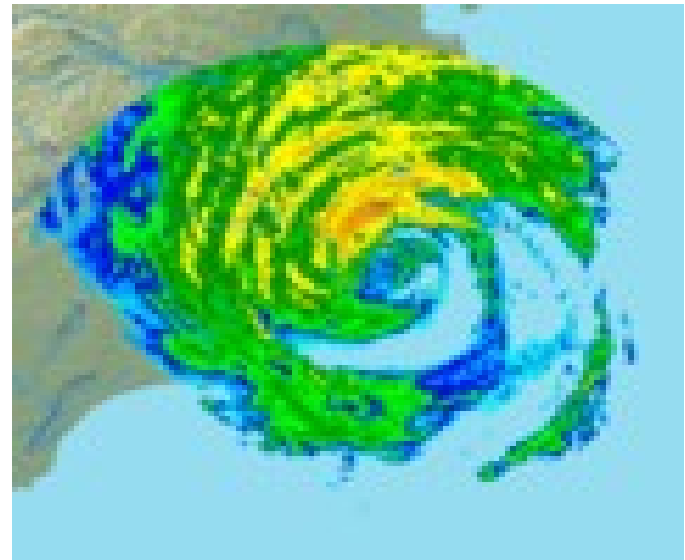


2011: A Year with Record-Breaking Billion-Dollar Weather Disasters

Hurricane Irene:
10 billion

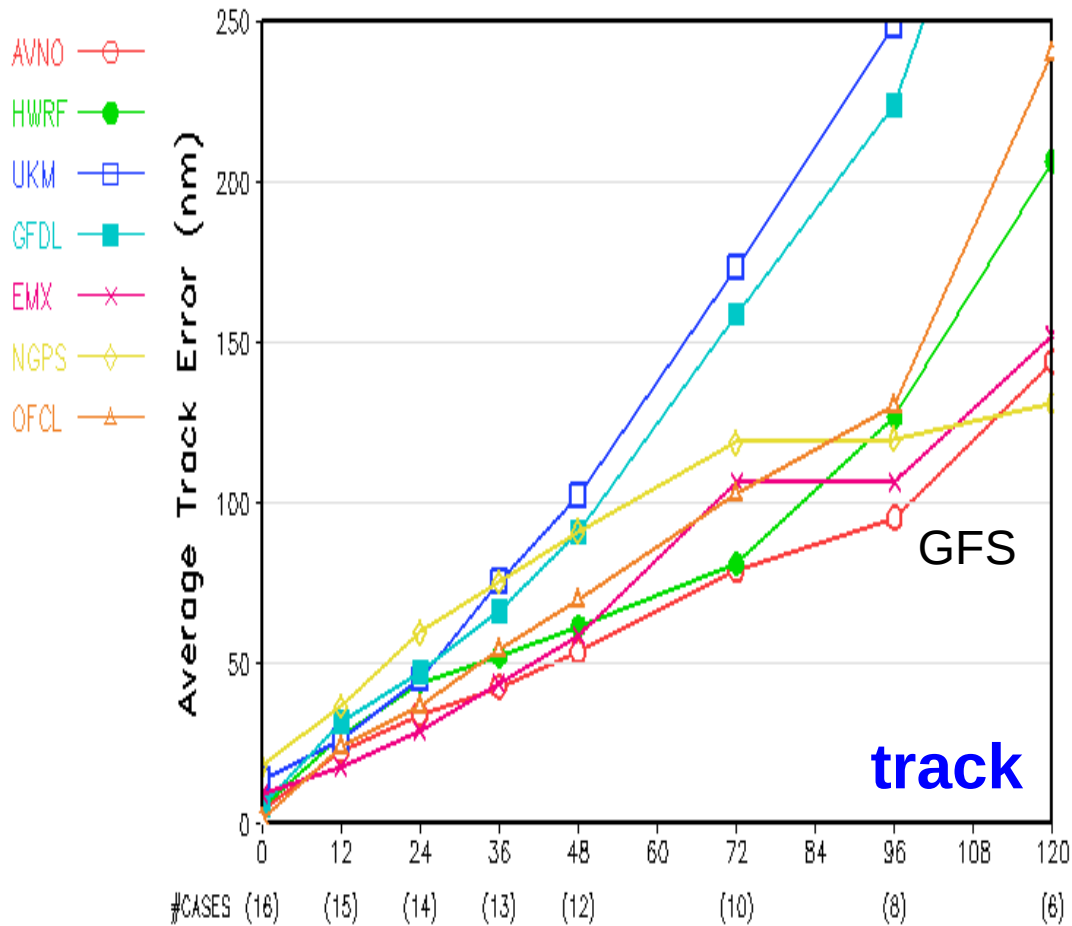
August 20-29, Cat 3

56 deaths



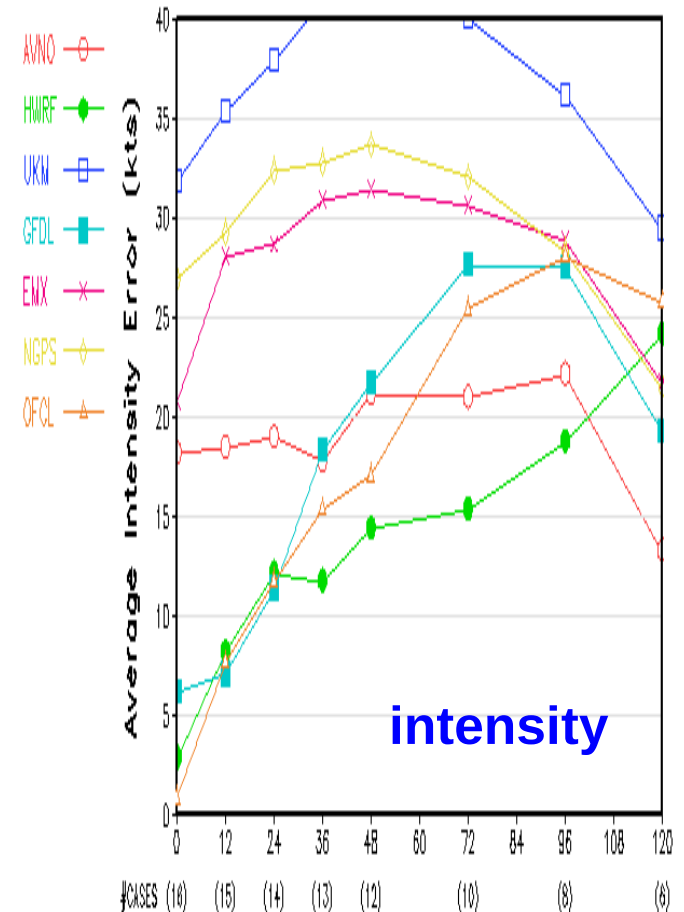
Hurricane Irene

Hurricane Track Errors – Atlantic 2011
Irene_al092011.dat_20110820–20110829_2cyc



GFS track forecast was one of the best

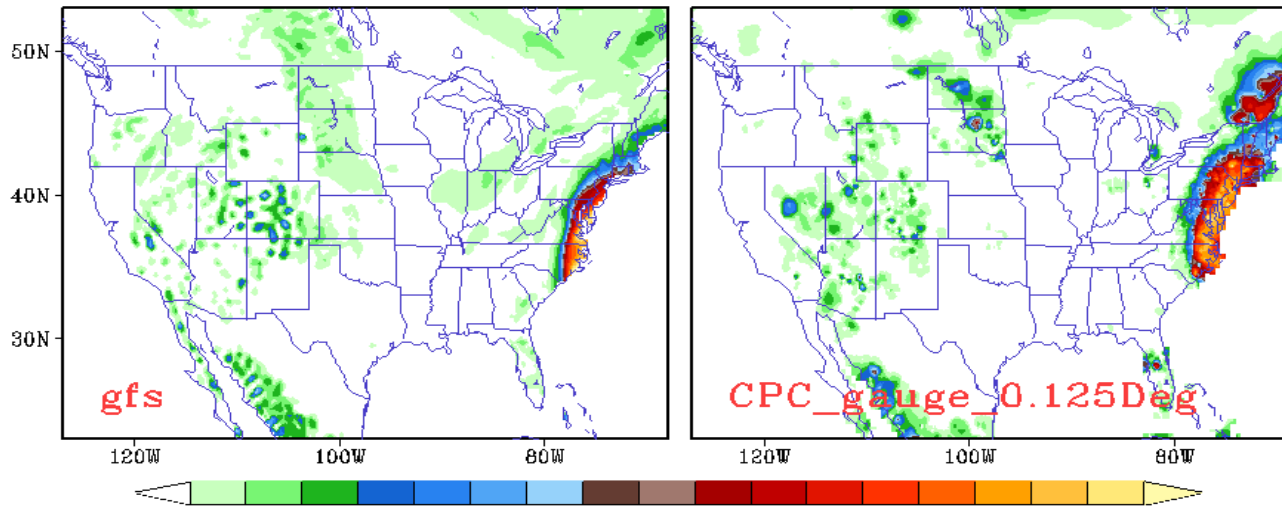
Hurricane Intensity Errors – Atlantic 2011
Irene_al092011.dat_20110820–20110829_2cyc



GFS intensity forecast was also better than other global NWP models

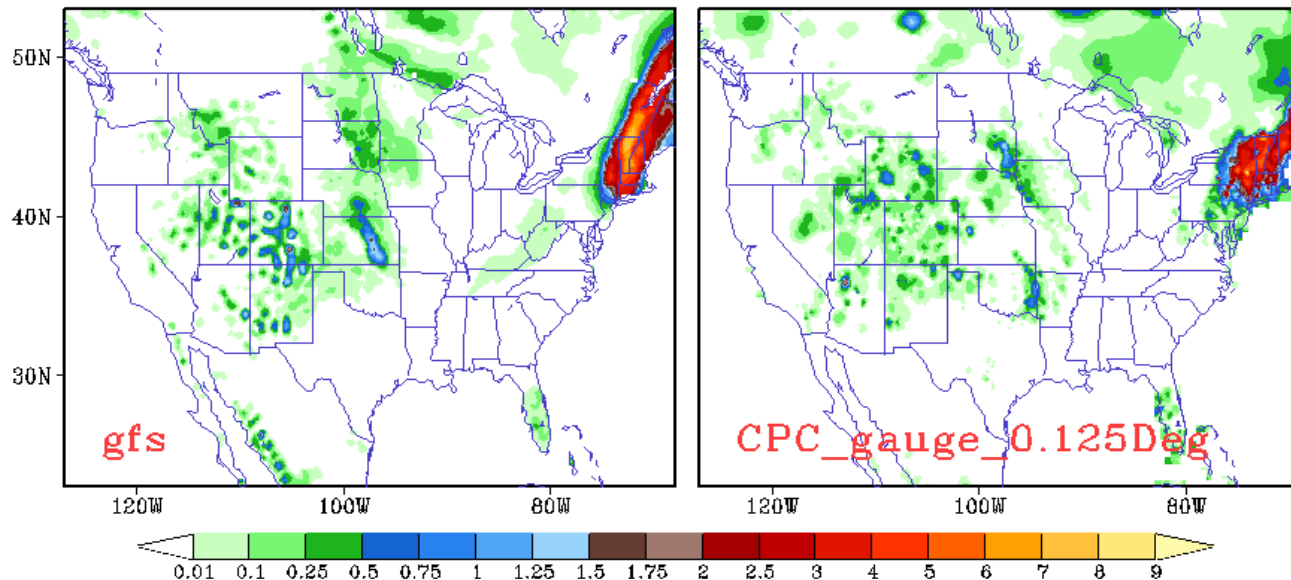
GFS 60-84hr Rainfall Forecast: Hurricane Irene

24-Hr Accumulated Precip (inch) Valid: 2011082712 – 2011082812
60hr to 84hr Forecast from Cycle 2011082500



24-hr rainfall,
valid at
12Z28Aug2011

24-Hr Accumulated Precip (inch) Valid: 2011082812 – 2011082912
60hr to 84hr Forecast from Cycle 2011082600



24-hr rainfall,
valid at
12Z29Aug2011

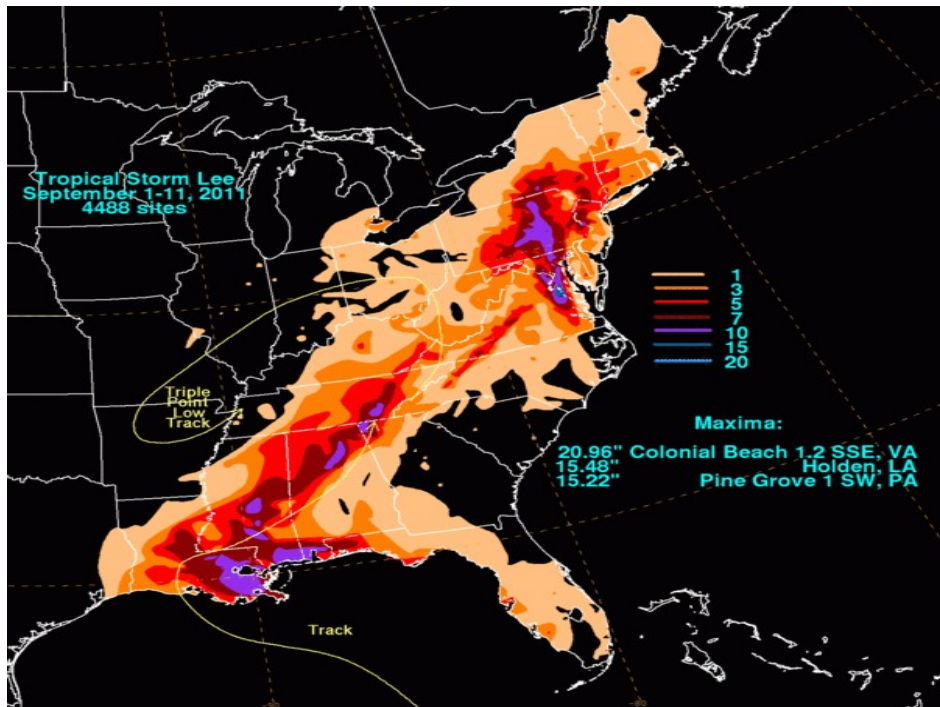
2011: A Year with Record-Breaking Billion-Dollar Weather Disasters



**Tropical Storm
Lee: > 1 billion**

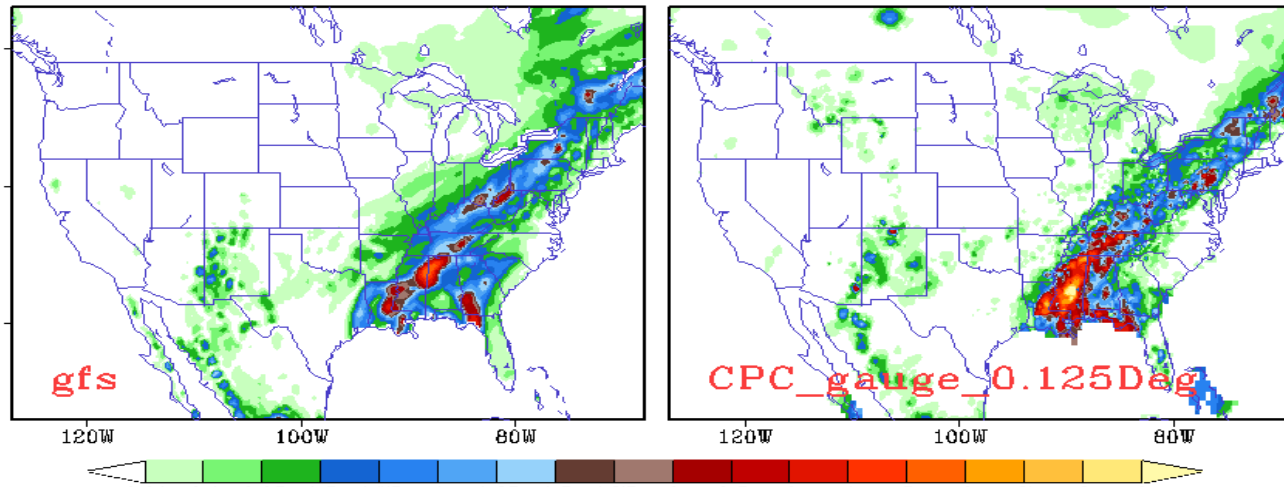
**September 1-5
21 deaths**

Due to the large size, as well as the slow forward movement of the storm, heavy rainfall occurred in southern Louisiana, Mississippi, Alabama, and the Florida panhandle, and caused historic flooding in Pennsylvania, New York, and elsewhere.



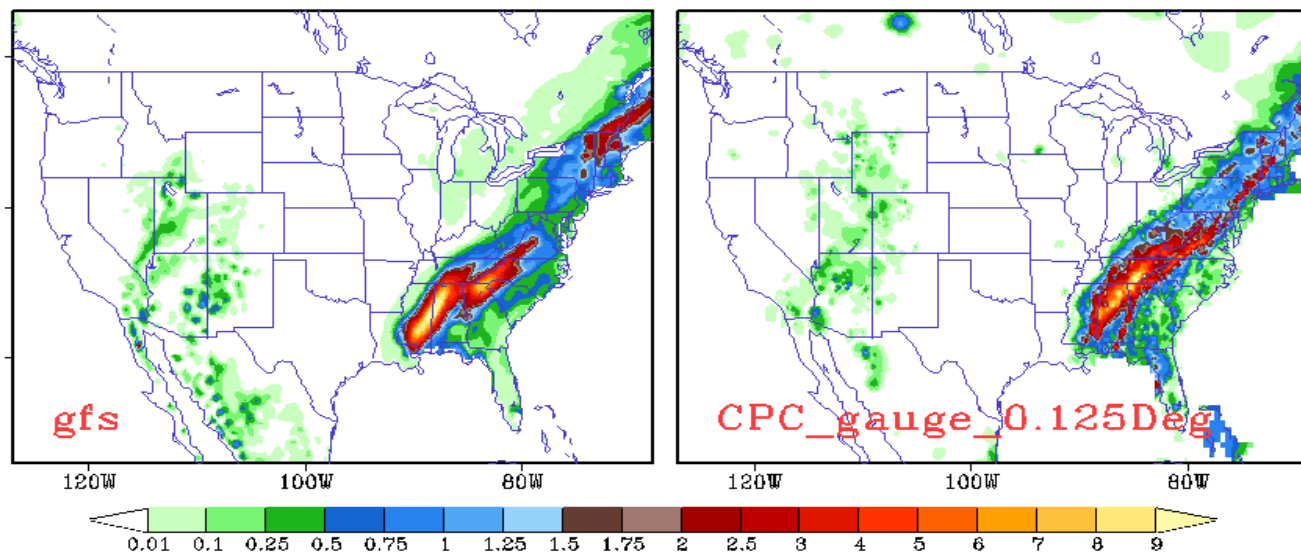
GFS 60-84hr Rainfall Forecast: Tropical Storm Lee

24-Hr Accumulated Precip (inch) Valid: 2011090412 – 2011090512
60hr to 84hr Forecast from Cycle 2011090200



24-hr rainfall,
valid at
12Z05Sep2011

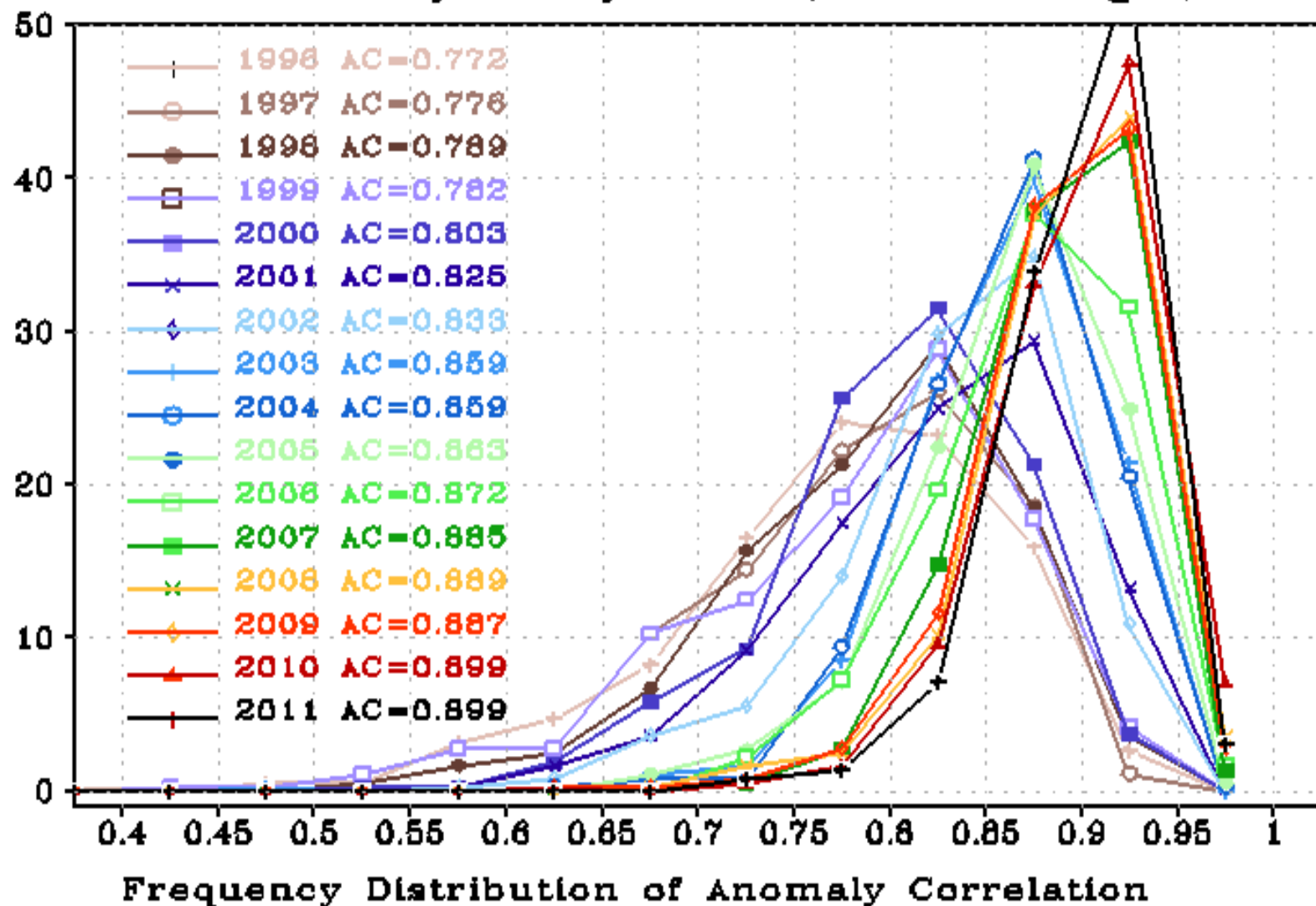
24-Hr Accumulated Precip (inch) Valid: 2011090512 – 2011090612
60hr to 84hr Forecast from Cycle 2011090300



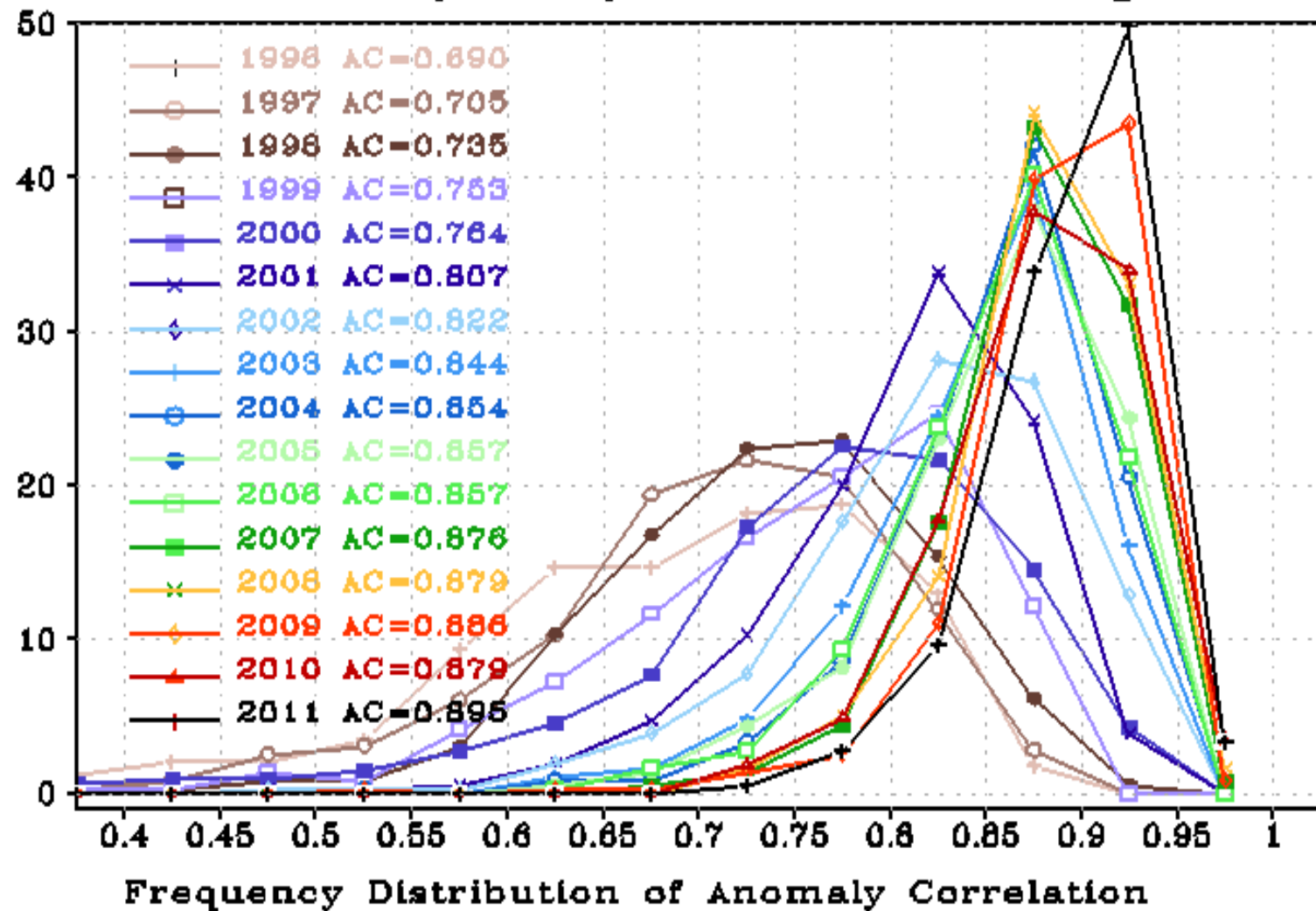
24-hr rainfall,
valid at
12Z06Sep2011

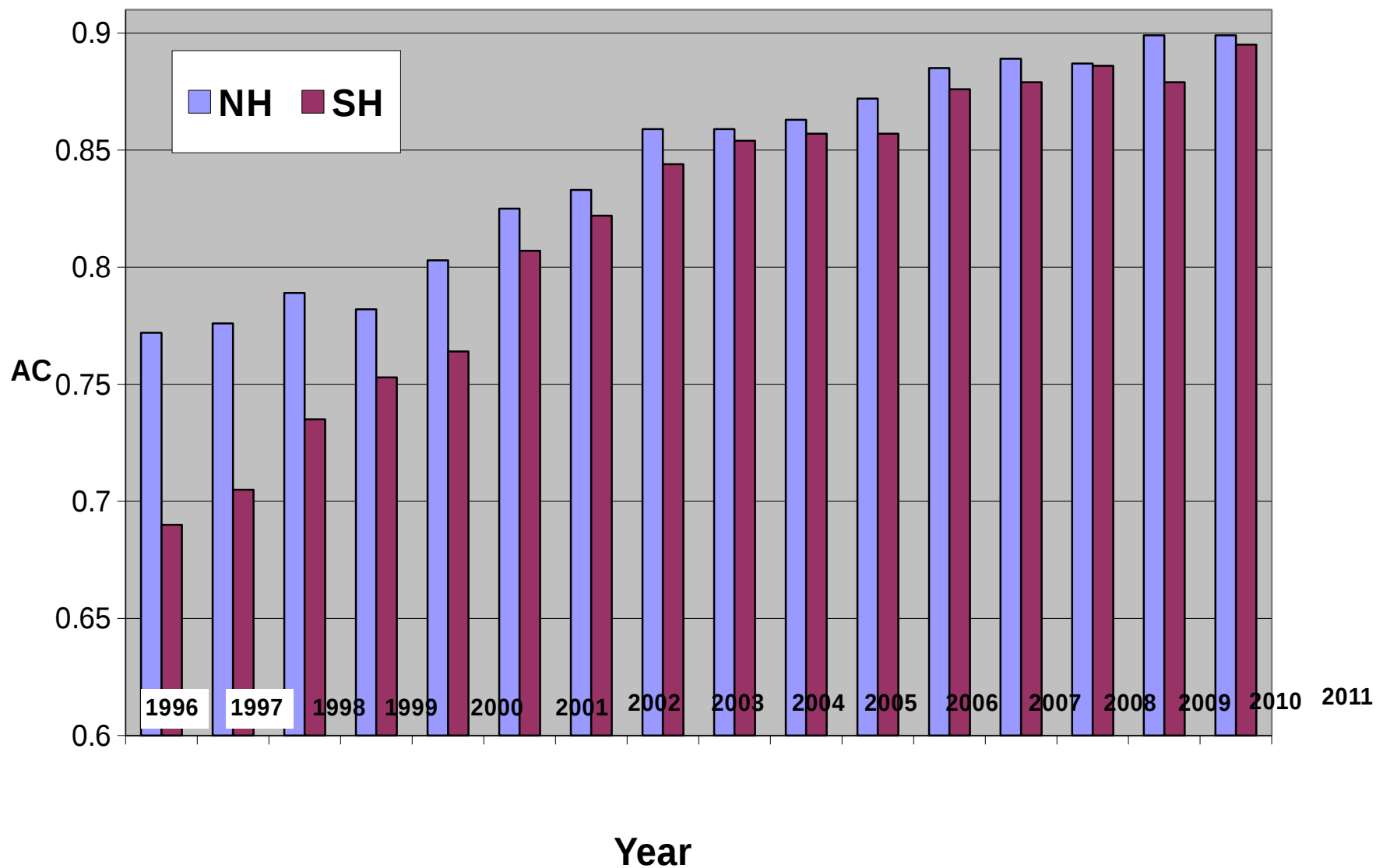
Supplemental Material

ECMWF 00Z-Cycle Day-5 Fcst, 500hPa Height, NH

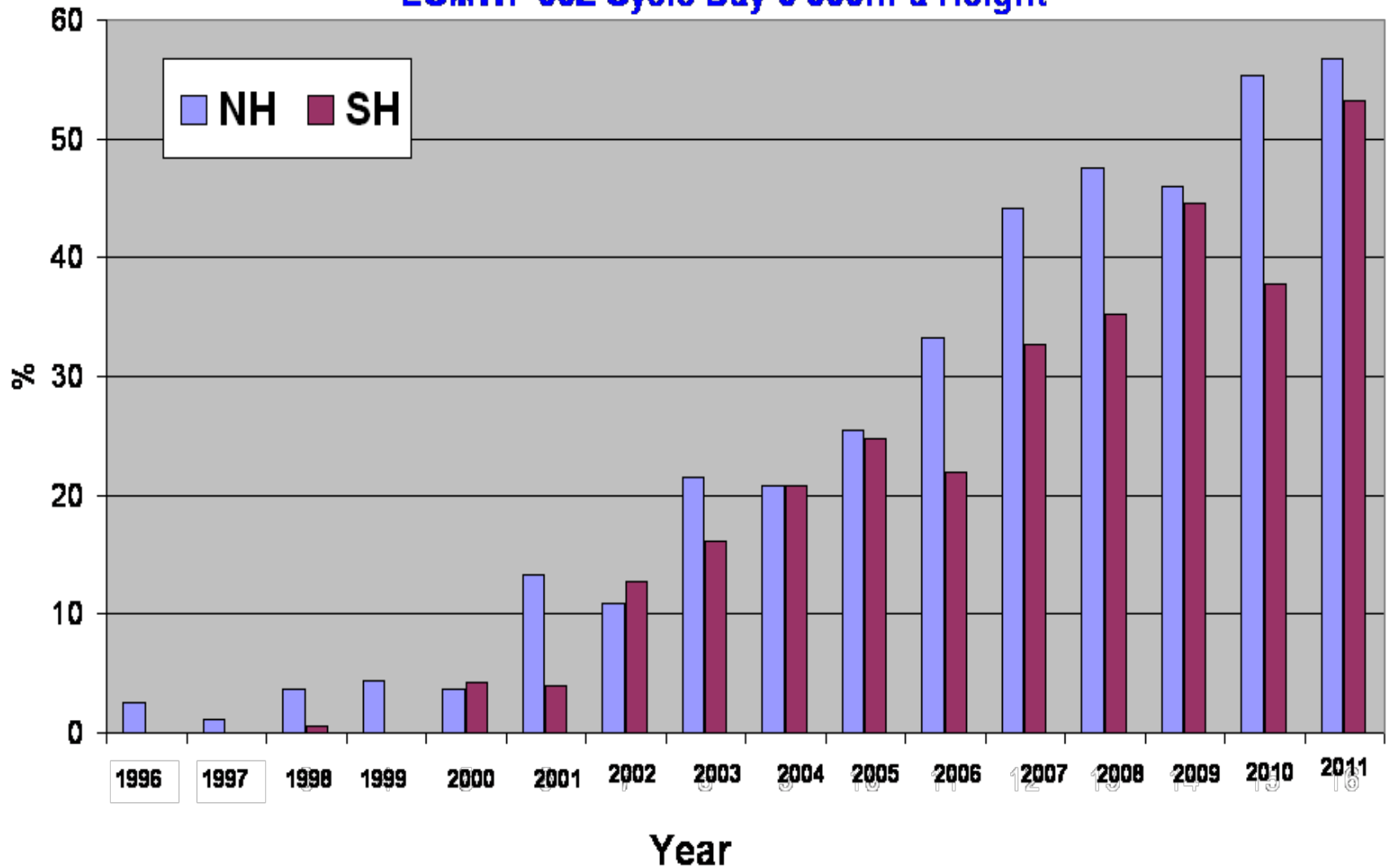


ECMWF 00Z-Cycle Day-5 Fcst, 500hPa Height, SH





**Percent Anomaly Correlations Greater Than 0.9
ECMWF 00Z Cycle Day-5 500hPa Height**



Percent Anomaly Correlations Smaller Than 0.7 ECMWF 00Z Cycle Day-5 500hPa Height

